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Pumps Made in Quantities

Special Facilities and Equipment in a Building Designed for the Purpose Are Responsible for the Production of Hand and Power Pumps on an Economical Basis

BY PAT DWYER

DESPITE the glowing and romantic picture presented by J. Fennimore Cooper and other delineators of early American history, touching on the habits and customs of the various Indian tribes, one is reluctantly driven to the conclusion that the sanitary conditions in their communities, must have been considerably below par. Practically every other people in the world, ancient and modern have made an attempt to convey water artificially from its point of origin to where it was used either for internal or external purpose. The ancient Romans had their magnificent aqueducts; the Persians had and still have the water wheels that lift the precious fluid from the Tigris and the Euphrates. Every people except the Indians used water copiously. Even in the late days of the eighteenth century when practically every town and village had developed some mechanical method of procuring water, the noble red man apparently was satisfied with an occasional sip from the nearest river. No statistics are available on the subject

FIG. 1—A CONTINUAL STREAM FROM THE CUPOLA IS DEFLECTED ALTERNATELY RIGHT AND LEFT BY A TILTING SPOUT INTO A FLEET OF BUGGY LADLES THAT CONVEY THE IRON TO THE VARIOUS FLOORS

of bathing, but a reasonable assumption is that it was dispensed with either altogether or limited to an occasional involuntary immersion when a canoe capsized and spilled its occupant into the waters of a lake or river.

The manner in which times and conditions change within a comparatively few years is illustrated to a marked degree in central New York state, once the home of the most powerful of the Six Nations. The name of the Senecas is perpetuated in almost universal local application. There are Seneca hotels, Seneca streets, Seneca oil filling stations. There is a Seneca river and a town Seneca Falls on the same river. In this town of Seneca Falls, a town named after an Indian tribe, whose members knew nothing about water except that it formed a convenient highway for their canoes, is located what is said to be the greatest establishment in the world, devoted exclusively to the manufacture of hand and power operated pumps.

Practically one-half of the capacity of the Gould Mfg. Co. is devoted to the manufacture of hand pumps which are distributed over America and many foreign countries. On one particular type which has been made continuously for 60 years, it is stated the annual output is 150,000. Centrifugal, power-driven pumps are made in capacities up to and including 60,000,000 gallons daily. Triplex pumps engaged in pumping oil through pipe lines are operated up to 900 pounds pressure and to a capacity of 15,000 barrels a day.

The history of the Goulds Mfg. Co., dates back to 1844 when Abel Downs and Seabury S. Gould made iron pumps in a small shop in Seneca Falls. Throughout the many changes that have

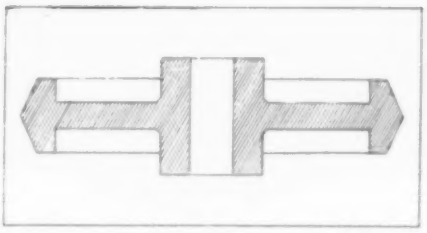

FIG. 2—DETAIL OF BUGGY WHEEL

taken place since that time, changes in location, personnel and plant, a direct descendant of the original Gould has been the executive head and the plant always has been operated in Seneca Falls. At present the plant occupies the greater part of a 78-acre property on the outskirts of the town and along the line of the New York Central railroad.

Among other interesting features of this plant it may be pertinent to mention that 2 miles of railroad track are laid in the yard and that approximately 24,000,000 pounds of product is shipped annually. Employes number 1000. The company maintains its own power house, pumps water to all parts of the plant from three artesian wells, maintains a safety first organization, a hospital and a mutual benefit association.

The foundry with which this description primarily is concerned is 500 feet long, 140 feet wide and forms one side of a large square, two other sides of which are occupied by machine and erection shops. One machine shop is devoted to machining and assembling hand pumps while the other specializes in power-driven units. Castings are divided roughly into these two main divisions and are made in that half of the foundry nearest the machine shop in which they are to be finished.

Every pattern used in the foundry is mounted in a manner that will permit its attachment to some one of the 92 molding machines with which the foundry is provided. These machines were supplied by various interests including the Herman Pneumatic Machine Co., Pittsburgh; Hanna Engineering Works, Chicago; Tabor Mfg. Co., Philadelphia; Osborn Mfg. Co., Cleveland, and Henry E. Pridmore, Inc., Chicago.

Location of the various molding machines and other pieces of operating equipment is shown in the illustration Fig. 3 which is a floor plan of the foundry and accessory buildings. A fair idea of the construction features of the building may be gained by referring to Figs. 10 and 11.

In many respects this foundry is in marked contrast to the ordinary conception of a place where castings are

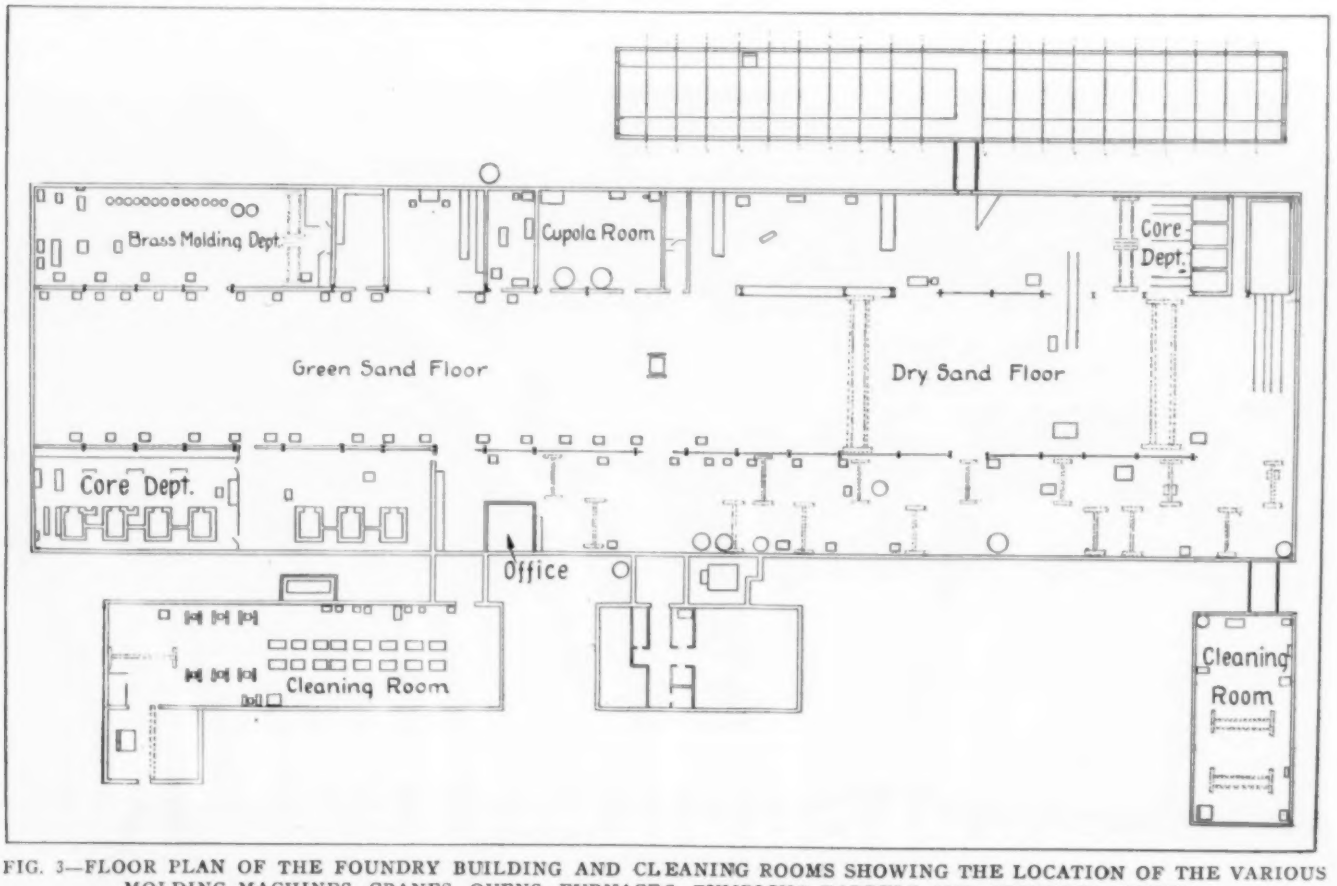

FIG. 3—FLOOR PLAN OF THE FOUNDRY BUILDING AND CLEANING ROOMS SHOWING THE LOCATION OF THE VARIOUS MOLDING MACHINES, CRANES, OVENS, FURNACES, TUMBLING BARRELS AND GRINDING WHEELS

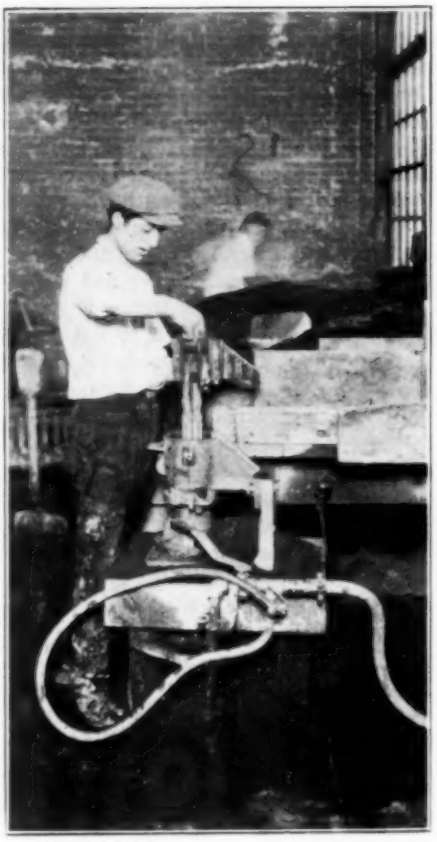

FIG. 4—A ONE-PIECE, CAST-IRON ARBOR IS PLACED IN THE TWO-PART PITCHER SPOUT COREBOX

produced. It is kept clean and tidy at all times and ample room is provided for the molds on the various floors. With the profusion of windows in the sides, ends and roof, with thousands of small molds symmetrically displayed on the floors and with the wide, smooth iron gangways extending from one end of the building to the other, the place is more reminiscent of a green house than a foundry. Perhaps the most intelligent way of presenting a description of the foundry is to take the floor plan Fig. 3 and consider it in detail commencing at the upper left corner and reading from left to right in the ordinary manner. It will be noted that the floor area is divided into the usual three bays by the two rows of steel columns that support the roof and the runways for two 10-ton electric traveling cranes made by the Alliance Machine Co., Alliance, O.

The brass foundry occupies the entire width of one of the side bays for a distance of 120 feet from the end. It is maintained as an individual unit and is separated from the adjoining main bay by a high wire partition. Molds are made on a battery of 14 machines located at convenient distances apart along the dividing partition wall and also at one end. The metal is melted in a battery of 16 coke-fired crucible pit furnaces with the covers slightly above the floor level and located in a line close to the wall of the building. The molds are set up close to the machines and in that manner a clear open space always is maintained in the center of the floor and in the vicinity of the furnaces. Order, symmetry and no crowding, features that characterize the remainder of the foundry, also are exemplified in this corner of the building where approximately 10 tons of nonferrous metal are melted and poured daily.

Minor repairs to pattern and flask

FIG. 6—THE GREEN-SAND PITCHER SPOUT CORE IS PRODUCED IN QUANTITIES ON A SMALL JOLT MACHINE

equipment are effected in a small machine shop enclosed between brick walls and adjoining the brass foundry on one side and a green-sand coreroom on the other. This coreroom is shown in further detail in Fig. 5. This department will be referred to again in its

FIG. 5—ONE MAN MAKES 540 GREEN SAND CORES EVERY DAY AND SUPPLIES THE NEED OF FOUR MEN MAKING THE MOLDS—THE CORES ARE PLACED UPRIGHT ON RACKS THAT ALSO SERVE FOR HAND BARROWS IN CONVEYING THE CORES TO THE MOLDING FLOORS

FIG. 7—GREEN-SAND CORES FOR THESE LONG PUMP BODIES ARE MADE IN A HINGED COREBOX—THE CORE FITS THE PRINT CLOSELY AT EACH END OF THE MOLD

proper place while considering the methods and equipment employed in producing several typical castings.

The cupola department occupies a space the full width of the side bay, 80 feet long and approximately an equal distance from either end of the building. It is equipped with one 78-inch and one 48-inch cupola made by Bryan & Co., Detroit, and provision is made for a second 42-inch cupola. The smaller cupola is employed when for any reason the heat does not exceed 30 tons. At the time the photographs were taken the average weight of the daily heat was 70 tons and the larger cupola was used continuously.

Owing to the severe service to which many of the castings are subjected and the exacting inspection they must pass, the mixtures for the cupola are made up entirely from pig iron, selected steel scrap and return scrap from the foundry itself. The analysis of the iron poured into the castings is held within close limits and for this reason it is not considered advisable to accept a certain element of risk involved in the use of foreign scrap in which the analysis at best is problematical. Cupola charges are made up in the proportion of 6000 pounds of iron to 700 pounds of coke.

Iron Mixtures

For purpose of making up the heat, all the castings to be poured are divided into three general classes and the various iron charges are made up from the available stock in the yard in such proportion as will yield iron of a suitable analysis for each of the three classes. The classifications are known as hard, soft and medium and usually the proportion of each required will vary from day to day. Also, the order in which the mixtures are poured occasionally has to be changed. Usually the hard iron is poured first, but if the molds destined to receive this iron are not ready according to schedule, the iron falling into one of the other classifications is charged first. The man in charge of distributing the iron is given either written or oral instructions indicating the amount of iron in each classification. He knows the capacity of each ladle and by checking them as they leave the cupola he is in a position to determine when the hard iron is all down and, therefore, can switch his ladles to the molds that require the medium iron, and later, to the molds to be poured with soft iron.

All the light castings made in green-sand molds are poured from soft iron with a silicon content of 2.40 per cent. Medium weight and heavy castings made in green and dry sand molds are poured from the medium mixture in which the silicon varies from 1.50 to 2.00 per cent. The castings designed for high pressure work are poured from a semisteel mixture in which the silicon content does not exceed 1.00 per cent. The thickness of the wall section in these castings varies from 1 inch to 2¼ inches and the iron in the ladle if necessary is doctored to meet conditions. The cupola melts iron at the rate of 24 tons per hour and, therefore, if the iron in the first ladle is too hard it is held for a few minutes and a calculated amount of a softer iron from a succeeding tap is poured into it from another ladle. The approximate hardness of the iron is judged from a test poured against a chill. The test molds are made in a small quantity of sand in an angle formed by lines of two intersecting gangways as shown at *A*, Fig. 1. It may be noted that the pig bed for left-over iron is located a little to the left in the same illustration. The test block used in this instance is 6 x 2 x 1 inch and is molded with the 1-inch face against the chill. It is allowed to cool to a red heat, then is dipped in water and afterward broken. The depth of the chill indicates to the experienced eye whether or not the iron in the ladle is suitable for the castings on a particular part of the floor.

Well Ordered Stock Yard

The pig iron is piled in ricks in the extensive stock yard immediately back of the foundry building and in close proximity to the cupola department. The building shown above and to the right in Fig. 3 is divided into a number of bins for the reception of coke and sand. It is served by an elevated railroad track through which the contents of the loaded cars are discharged through trap doors in the roof of the building. Coke and iron are taken by elevator to the charging floor. Scrap and sprue in the foundry are collected and loaded into large steel pans which

FIG. 8—LIGHT, CAST-IRON FLASKS APPROXIMATE CLOSELY THE SHAPE OF THE CASTING AND MINIMIZE THE AMOUNT OF SAND REQUIRED

afterward are lifted one at a time by one of the cranes in the center bay and landed on the platform projecting from the charging floor under the crane runway. Several of these pans are shown at the extreme right in Fig. 1 and the platform may be noted to the left above the center in the same illustration.

Blast for the cupola is supplied by a blower furnished by the P. H. & F. M. Roots Co., Connersville, Ind. The blower, together with a smaller unit for the second cupola, is housed in a room adjoining the cupola room on the left and protected from outside influence by a brick wall. The stock room provided with all the necessary material for keeping the cupolas in repair is in a second room partitioned in a similar manner from the cupola room on the right.

Delivering the Iron

The manner in which the iron is distributed to all the light work floors is illustrated in Fig. 1. The iron runs in a continuous stream from the beginning to the end of the heat. A tilting transverse spout in front of the regular cupola spout serves to direct the stream alternately right and left into a waiting 1000-pound ladle. Each ladle tender tips the spout by a long pipe handle attached to a short lever on the lower side of the spout. The instant the lever is released the spout becomes horizontal through action of gravity.

FIG. 10—CONTINUOUS ROWS OF WINDOWS IN THE WALLS AND ROOF INSURE EXCELLENT LIGHT ALL OVER THE FLOOR—THE HIGH MONITOR ROOF OVER THE CENTER BAY GIVES ADEQUATE VENTILATION

The ladle is mounted on a ball bearing three-wheel buggy easily manipulated by one man. The front wheel is smaller than the others and is mounted in a fork which permits it to swivel from right to left. With this arrangement the buggy may be turned in its own length. To conserve the heat, each ladle is provided with a circular, slightly conical cover. This cover also prevents any iron from slopping over the sides during the progress of the buggy up and down the gangway. The tread of the solid, cast-iron wheels on the buggies is not flat as in ordinary wheels. It presents a sharp ridge in the center as shown in Fig. 2. It is claimed that this is a safety feature and prevents the wheel from jumping in the event that it passes over any slight obstruction on the gangway. Other interesting features of the company's safety first policy may be noted in Fig. 1 where every man handling a ladle is shown equipped with goggles and leggings.

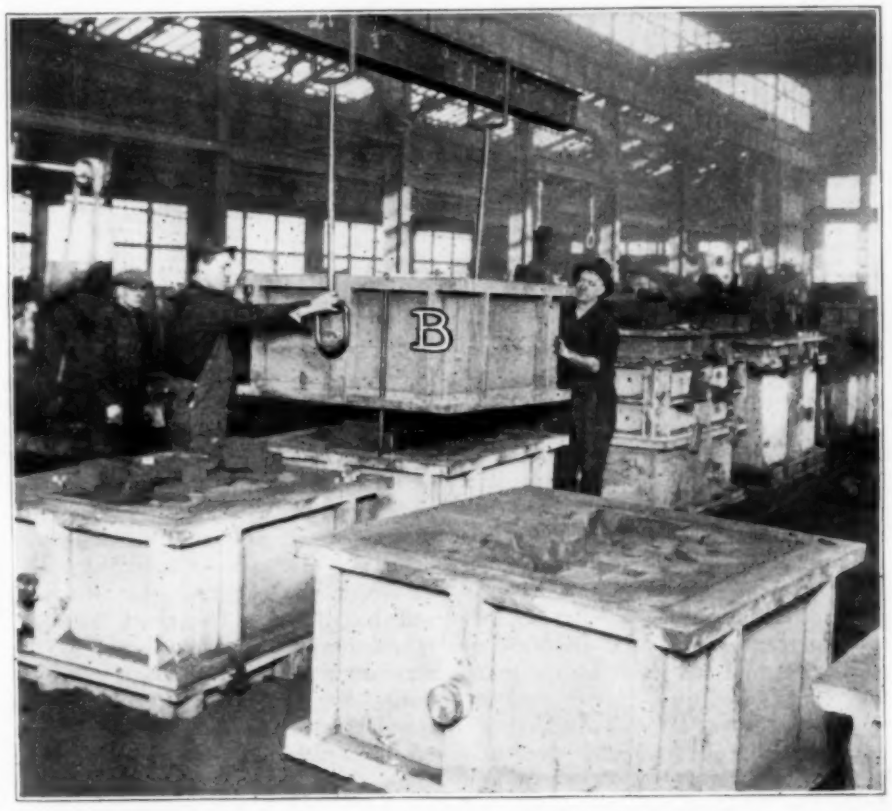

FIG. 9—STRONG, SUBSTANTIAL IRON FLASKS REINFORCED WITH NUMEROUS RIBS AND PLANED ON THE JOINTS ARE EMPLOYED ON THE DRY SAND FLOOR

In the central bay of the foundry, a 6-foot cast iron gangway extends along the middle of the floor the full length of the building. The molding machines are placed along the column line and the floors of molds are laid down from the gangway back to the machines on either side. In the upper side bay Fig. 3 the gangway is located close to the dividing column line, the molding machines are close to the wall and the molds are laid down from the gangway back to the machine. In the lower bay the gangway extends through the center as in the main bay and the molding machines and molds are arranged in the same manner.

Core Ovens

The upper bay for a distance of 160 feet to the right of the cupola room is devoted to the production of various types of long pump bodies. A close-up of two typical floors is shown in Figs. 7 and 8. The mold is made in a special flask shaped to follow closely the contour of the casting. With this construction the total volume of sand

is reduced to a considerable extent and the flask is reduced to a size that may be handled conveniently by one man. The flask is made of cast iron with sides and ends less than ½ inch in thickness and is provided with a single steel loop handle at each end. The long, green-sand core is made in a hinged metal corebox. A cast iron arbor is placed in one half of the box, then both halves are rammed full of sand and brought together to form a complete core. A ½-inch steel rod that is rammed up with the sand at the approximate center of the core, is pulled out before the box is separated. The opening left by the rod serves as a passage for the escape of the steam generated in the core while the mold is filling with iron. The upper half of the box is rolled back on its hinges, the core is lifted out and placed in the mold.

A core room and core ovens for large cores and dry sand molds occupy the remaining space in the upper bay. Openings in four, car-type, coke-fired ovens, 8 x 15 x 8 feet, face the core department in the side bay. The large mold oven in the extreme corner is 16 x 35 x 10 feet and is served by cars on a double track that extends into the main bay of the foundry where the loads may be handled by one of the 10-ton cranes. Practically all the molds made in this section of the foundry are dried; hence the large oven capacity. Dried molds form a species of insurance against many of the ordinary foundry hazards to which castings in green sand molds are subject. The majority of the castings are of intricate design and the molds are filled with a great number of close fitting cores. In this connection it is interesting to note that top chaplets have been eliminated wherever the cores have been provided with bottom prints. A long perpendicular opening is provided at a convenient point in the core and after the core is placed in the mold, a lag screw with a head and washer at the upper end is inserted in the opening. The opening is countersunk on the top for the reception of the screw head so that when the lower end of the screw is anchored in the bottom board, the washer at the upper end is bearing firmly on the shoulder in the countersunk opening. The opening is made large enough to accommodate the end of a small socket wrench employed in tightening the screw. The space over the bolt head afterward is filled with sand and dried with a torch.

FIG. 11—LIFTING FACILITIES IN THIS BAY ARE PROVIDED IN THE SHAPE OF NUMEROUS AIR HOISTS SUSPENDED FROM SUITABLE LIGHT BRIDGES

Dry Sand Floor

A view of part of the dry sand floor is shown in Fig. 9. The cast iron flasks are substantially constructed and heavily ribbed to prevent distortion from constant journeying back and forth to the drying oven where they are raised to a comparatively high temperature. The joints are machined to a true plane and holes for the guide pins are drilled accurately in the flanges of the copes and drags. In the majority of cases, the cores extend high into the cope and it becomes necessary to employ long guide pins while lowering the cope into place. In some instances the long guide is attached to the drag and the cope is lowered down over it. At other times as illustrated at *B*, Fig. 9, the long guide is held in the cope and the lower point is inserted in the pin hole in the drag flange while the cope is at a considerable height above the surface of the cores.

The flasks are provided with trunnions and are handled with a steel beam and a pair of slings in the manner shown in Fig. 9. Marks painted on the beam at graduated distances on both sides of the center, assist the molder in setting the slings so that the flask will hang level. The cope flasks are provided with shallow bars and by this arrangement they are available for practically any pattern that may be enclosed between the sides and ends. Wherever necessary, long gaggers are placed in the cope to carry the hanging body of sand. Nearly all the molds on the dry sand floor are rammed on a large jolt machine which was supplied by the

Tabor Mfg. Co., Philadelphia.

Sand on the molding floors is prepared for use by a sand cutting machine made by the American Foundry Equipment Co., New York. A smaller machine made by the same company mixes the facing and core sand on a concrete floor in that part of the main bay adjoining the core room. The new sand is wheeled in from the sand shed in barrows and the prepared sand is taken to any required part of the floor in a pan suspended from the crane. Small steel water tanks used in connection with preparing the sand are located at various convenient points throughout the shop.

With the exception of a space in front of the cupolas all the floor space on both sides of the center gangway and shown to the left in Fig. 3 is devoted to snap flask molds made on a battery of squeezer machines located in a long row on both sides of the main bay. Instead of wood jackets and wood bottom boards malleable iron jackets and plates are employed. The bottom plates are pierced with small tapered vent holes set closely together and it is stated that although they originally cost more than wood boards, they long since have outlived their cost when compared to the cost of wood boards over the same period. Where the character of the castings warrant their use, small iron flasks are employed to contain the molds. One of these is the pitcher spout hand pump casting previously referred to as made in such large quantities. Four men make the molds, 135 each per day and one man makes the 540 green sand cores required for the entire number.

Use Split Pattern

The molds are made from a split pattern in an ordinary two-part flask and present no particular points of novelty. The cores are made in an exceedingly ingenious and rapid manner illustrated in Figs. 4, 5 and 6. They are laid horizontally in the molds, but they are rammed vertically and stored vertically on racks before they are placed in the molds.

The metal corebox is in two parts with one part attached firmly to the table of a small jolt machine. The second part is removable. When in use it is held firmly against the first half by a narrow band the ends of which engage two lugs on the permanent, half corebox. The ends project through the lugs and are held in place by tapered keys that are placed in slots provided for the purpose. Part of each key is bent at right angles at the top so that the operator readily can remove it preparatory to taking the corebox apart. Based on a daily output of 540 cores and allowing for a full day of 8 hours, the output is approximately 68 cores per hour or one every 35 seconds. For purpose of demonstration the operator shown in the illustration has made a test core in 14 seconds.

A one-piece, cast-iron arbor provided with numerous ribs is employed to give the core the necessary rigidity. In practice the seat is blown clean with an air hose, the detachable half of the box is clamped in place, the clay-washed arbor is lowered into place and automatically locates itself by suitable iron bearings on the bottom and on the lip of the spout. The coremaker then throws a shovelful of sand into the box, admits the air to the jolting cylinder and administers the required number of blows. The sand is scraped off flush with the open end of the box, then the keys are removed from the retaining band with both hands and the same movement serves to remove the loose part of the box and place it to one side temporarily. The coremaker then grasps the core by the top and bottom as shown in Fig. 6 and lifts it from the box to one of the stands shown in Fig. 5. The stands later serve as hand barrows to convey the cores to the floors where the men are making the molds.

Core Making Department

Small and miscellaneous cores for all the green sand molds in the iron and brass foundry are made and dried in the department which occupies one-third of the area to the left of the lower foundry bay as it is shown in Fig. 3. The coreroom is divided into two parts, one for the male and the other for the female employes. Each section is equipped with all the necessary appliances to render it a self-contained unit. The various operations are divided among the employes so that each one

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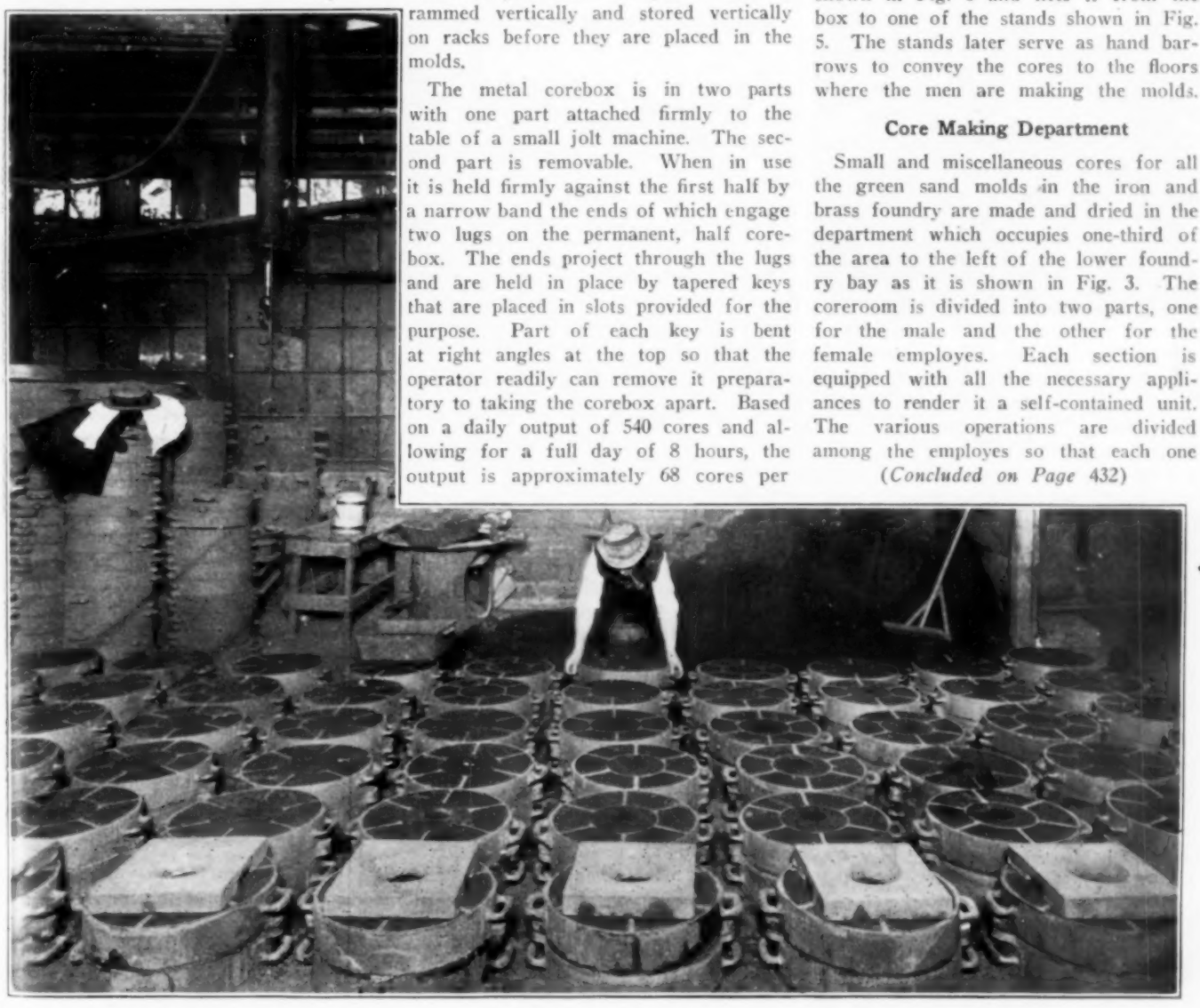
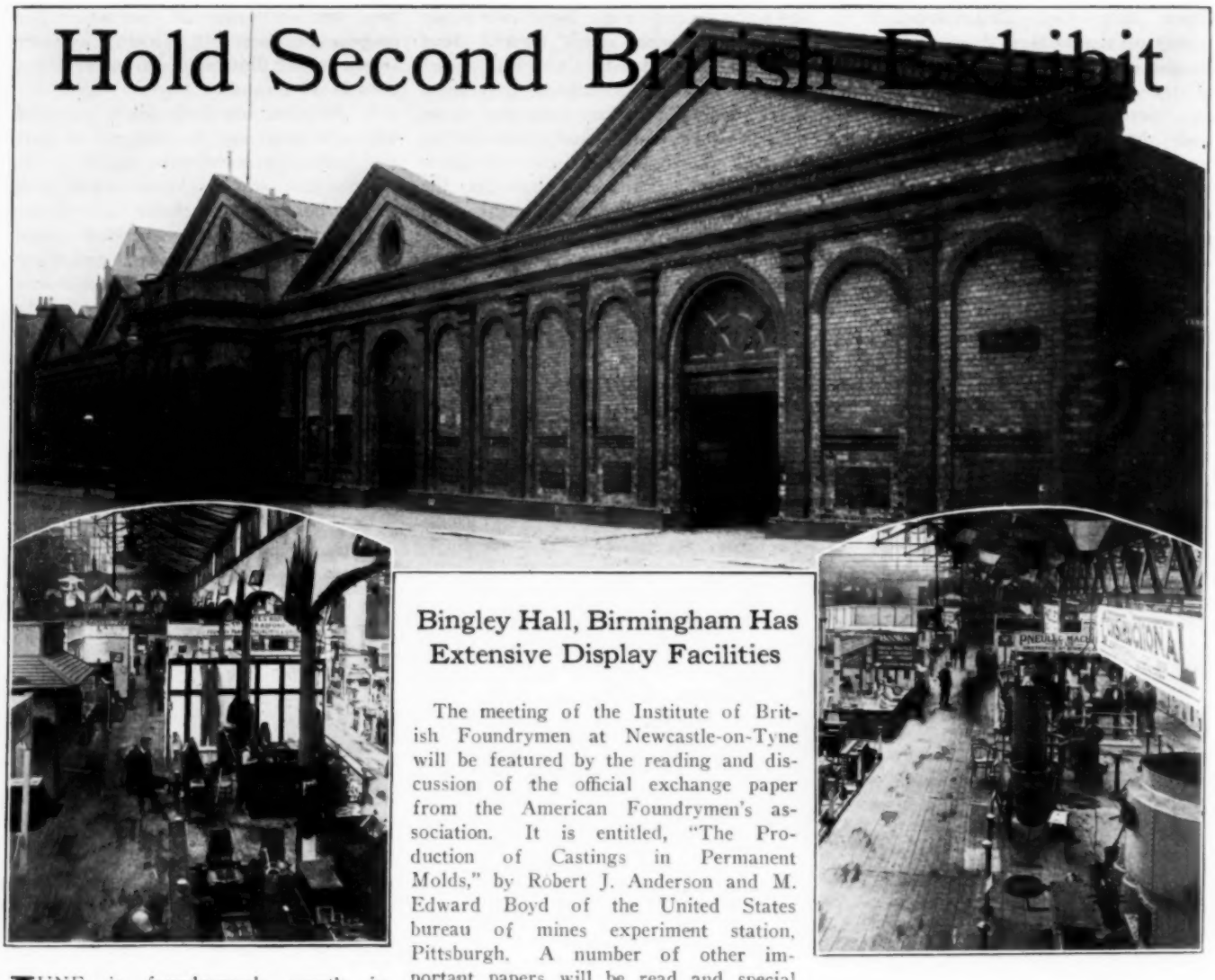


FIG. 12—SMALL PULLEYS ARE MOLDED ON A BATTERY OF STRIPPING PLATE MACHINES ONE OF WHICH IS SHOWN IN THE CENTER BACKGROUND—EACH MOLD IS POURED THROUGH A SMALL BASIN AND STRAINER CORE ON THE TOP OF THE HUB

Hold Second British Exhibit



Bingley Hall, Birmingham Has Extensive Display Facilities

The meeting of the Institute of British Foundrymen at Newcastle-on-Tyne will be featured by the reading and discussion of the official exchange paper from the American Foundrymen's association. It is entitled, "The Production of Castings in Permanent Molds," by Robert J. Anderson and M. Edward Boyd of the United States bureau of mines experiment station, Pittsburgh. A number of other important papers will be read and special arrangements also are being made to afford the visitors an opportunity to study the foundry practice of the important Newcastle district, where a number of large shipbuilding and engineering establishments are located.

JUNE is foundrymen's month in Great Britain. Two important events are scheduled to take place. First comes the annual meeting of the Institute of British Foundrymen, which will be followed at an interval of a week by the second International Foundry Trades exhibition. The latter will continue for 10 days. It has been found inexpedient this year to hold the convention of the Institute of British Foundrymen and the exhibition at the same time and place. Birmingham has special show facilities which are difficult to duplicate, while on the other hand one of the unwritten laws of the British foundrymen's association is that the annual meeting shall go to the town where the incoming president resides.

Therefore, this year the Institute of British Foundrymen will hold its convention in Newcastle-on-Tyne, June 4 to 6, under the presidency of R. O. Patterson. The exhibition will take place in Birmingham, at Bingley hall, June 19 to 28. The fullest co-operation is being maintained, the Institute of British Foundrymen being a patron of the exhibition. The compact geography of the British Isles insures the success of both of the meetings arranged.

Many Societies Co-operate

As was the case in 1922, the exhibition at Bingley hall, Birmingham, will be managed by the exhibits department of the Birmingham chamber of commerce under the direction of Charles Stanley. In addition to the Institute of British Foundrymen, the following societies and organizations are among those participating in the International Foundry Trades exhibition: The British Cast Iron Research association; National Light Castings association; South Staffordshire Ironfounders association; Cast Iron Holloware Manufacturers' association; Institution of Mechanical Engineers; Institute of Metals; British Nonferrous Metals Research association; and Brassfounders Employers' association.

By the end of April the success of the exhibition was fully assured and there is little doubt now but that it will surpass that of 1922. A partial list of exhibitors, up to April 20, is presented herewith. This indicates that a large number of interesting displays are assured. American foundry machinery will be amply represented, including Osborn molding machines, which will be shown at work by J. W. Jackman & Co., Ltd., Manchester, and the Beardsley-Piper sand-slinging molding machine displayed by Foundry Plant Machinery Ltd., Glasgow. The exhibit of the Penton Publishing Co., Cleveland and London, publisher of THE FOUNDRY, *Iron Trade Review*, *Abrasive Industry*, *Daily Metal Trade*, etc., will include specimen copies of modern engineering and business publications, and a large number of original photographs illustrating American and European methods of making castings.

In all essential features the exhibition of 1924 will follow its predecessors, with such improvements as experience has indicated to be desirable. The 1922 exhibition was visited by 3000 foundrymen, many of them coming from overseas or in special trains from distant parts of the United Kingdom. When the foundry show takes place this year, the big British Empire exhibition at

London will be going full blast, a factor which is expected to bring a much larger influx of foreign visitors than usual.

Birmingham has many advantages as a center for a display of foundry equipment and supplies. Foundries, ferrous and nonferrous, in the Midland area number several hundred, and the central situation of the city renders it conveniently accessible from the principal engineering districts. Representative industrial men and experts hold official positions in the exhibition and are giving it practical aid. The Rt. Hon. Lord Weir of Eastwood, G. & P. Weir Ltd., Glasgow, is president, and the vice presidents include Vice Admiral Sir George Goodwin, London; Douglas Vickers, M. P., Sheffield, and the presidents of about 20 leading associations including those enumerated previously.

The executive committee of the exhibition has as its chairman, H. Lakin Smith, vice president of the Birmingham chamber of commerce, and includes G. C. Vyle, the president of the chamber, and the acting head of W. & T. Avery Ltd., Birmingham; J. G. Pearce, director of the British Cast Iron Research association; J. E. Fletcher, consulting engineer, and a large number of practical foundrymen holding leading positions in important countries. The international aspect has been borne in mind by the inclusion on the general committee of H. Cole Estep, representing the United States; Emile Ramas, representing France; and Joseph Leonard acting for Belgium.

The technical advisory committee has for its chairman J. E. Fletcher, and includes J. G. Pearce of the Cast Iron Research association; Charles Heggie, past president of the Institute of British Foundrymen, E. Ronceray of Paris and several well known experts.

The exhibits have been classified into 18 groups, including general foundry equipment, foundry supplies, pattern-making equipment, molding sand, laboratory equipment, refractories, die castings, raw materials and fuel, cranes, hoists, etc. A department will be devoted to finished goods, covering a wide variety of products. There will also be co-operative exhibits by British trade groups displaying gray-iron foundry work, malleable foundry work, semi-steel castings, cast-iron rolls, nonferrous castings, and steel castings.

Educational Features

The educational side of the show has received special consideration, and arrangements have been made for what are called historical and statistical exhibits. During the exhibition there will also be lectures on foundry subjects and papers by members of various technical societies. Full use is to be made of motion pictures for showing modern methods of manufacture. For the reading of papers a special foundry congress is to be held from 3 to 5 p.m., on June 25, 26, and 27. This matter is in the hands of Dr. Aitchison and Charles Stanley, and several well known authorities have already promised to give lectures or papers. Numerous societies and associations have intimated their wish to take part in this congress.

One of the attractions of the first exhibition was the large amount of machinery in operation. To meet the requirements of the 1924 show in the way of motive power, a central station is to be provided and the necessary electricity will be furnished by the installation of a ring power main connected with the Birmingham municipal electrical station.

One of the great features of the 1922 show was the marked success of the competitions in which the junior members of the trade showed keen interest. The patternmaking competition alone attracted 377 entries. It is intended to carry out this work this year on a much wider scale, and prizes for successful competitors are being liberally contributed. Some difficulty was found on the last occasion because of the inability of some competitors to attend in the daytime and this difficulty will be overcome by the arrangement, where necessary, of evening competitions. The Municipal Technical school has placed its plant and equipment at the disposal of competitors who have not the necessary facilities either at their shops or homes to qualify for the competitions.

A number of the details have already been arranged. Class A offers prizes of £3 3s and £2 2s or about $15 and $10 for making the best core for light, medium and heavy castings. The winner of the first prize in each section will also receive a diploma from the Birmingham chamber of commerce, and a registration prize of a foundry technical book will be given to each competitor.

Class B offers a first prize of £5 5s, a second prize of £3 3s and a third prize of £2 2s for making the best mold in each of the following sections: Floor molding, two-part work, three-part molding, and false core work-ornamental molding. In this class also the chamber of commerce diploma and the consolation prize is offered.

In class C similar prizes are offered for making the best pattern to a blue print design to be supplied to each competitor. In this class approval has been given to a suggestion emanating from A. Smith of Morris Motors Ltd., Oxford, who has supplied a drawing of an induction pipe for the pattern-making test. The committee has sug-

Partial List of Exhibitors at British Foundry Show

T. J. Prisetman, Leopold street, Birmingham.
Nicholson & Clipper Co., Ltd., King street, Salford, Manchester.
W. Cumming & Co., Ltd., Kelvinvale Mills, Maryhill, Glasgow.
W. Canning & Co., Ltd., Gt. Hampton street, Birmingham.
J. M. Terry & Co., Gt. Hampton street, Birmingham.
Jas. Turnbull, 3 New street, Birmingham.
W. Allday & Co., 38 Paradise street, Birmingham.
Ritchie Hart & Co., Ltd., Mountpottinger Foundry, Belfast, Ireland.
Bradley & Foster, Ltd., Darlaston Blast Furnaces, Darlaston.
Thomas & Bishop, Ltd., 37 Tabernacle street, London, E. C. 2.
The Carborundum Co., Ltd., Trafford Park, Manchester.
THE FOUNDRY, Cleveland and London.
Richard Lloyd & Co., Steelhouse Lane, Birmingham.
Marley Hill Chemical Co., Ltd., 39 Lombard street, London. E. C. 3.
J. Williams (Birmingham Sand) Ltd., Foundry Sand Quarries, Birmingham.
Fordath Engineering Co., Ltd., Hamblet Works, West Bromwich.
Shotts Iron Co., Ltd., 1 Castle street, Edinburgh.
Thos. E. Gray & Co., Ltd., 119 High Holborn, London. E. C.
Spermolin, Ltd., Black Swan Works, Halifax.
Easilit Blow Lamp Co., Ltd., 34 Watford Road, Kings Norton, Birmingham.
Universal System of Machine Moulding & Machinery Co., Ltd., 97 Queen Victoria street, London. E. C. 4.
Sterling Foundry Specialists, Ltd., Sterling Works, London Road, Bedford.
F. Davidson & Co., 29 Gt. Portland street, London. W. 1.
Iron Trade Review, Cleveland and London.
Nobel Industries, Ltd., Nobel House, Buckingham Gate, London. S. W. 1.
Foundry Plant & Machinery, Ltd., 28 Royal Exchange Sq., Glasgow.
Stella Gill Coke & Bye Product Co., Ltd., Milburn House, Newcastle-on-Tyne.
Pneulec Machine Co., Ltd., Mafeking Road, Smethwick.
Frys (London) Ltd., 46 Upper Thames street, London. E. C. 4.
W. & T. Avery, Ltd., Soho Foundry, Birmingham.
Abrasive Industry, Cleveland and London.
Foundry Trade Journal, London.
General Refractories Co., Ltd., Kelham Island, Sheffield.
Penton Publishing Co., Caxton House, London. S. W. 1.
Selas-Turner Co., Ltd., Priory House, Priory street, Coventry.
J. W. Jackman & Co., Ltd., Vulcan Works, Blackfriars Road, Manchester.
Britannia Foundry Co., Cox street, Coventry.
W. & C. Pantin, 147 Upper Thames street, London. E. C.
John McDonald & Co., Pollokshaws, Glasgow.
Fredk. Mountford, Birmingham, Ltd., Moseley street, Birmingham.
Smeeton Wright Furnaces, Ltd., St. Stephens House, Victoria Embankment, London. S. W. 1.
A. Guttmann, Altone, Hamburg, Germany.
A. Collin, (Patents), Ougree, Liege, Belgium.

gested that the design should take the form of a T-pipe pattern and half-core design involving a slight modification of the original proposal. This competition is intended to test the ingenuity of patternmakers from the standpoint of the suitability of the casting for quick production. For one of the molding tests, Mr. Smith suggested an ordinary foundry ladle of small size with a good taper, the mold to be made 1½ inches deeper than the shell pattern. As an alternative a design of a hand wheel with dished arms has been approved, Prof. Thomas Reid of the Birmingham Technical school providing the drawing. A special prize of £10 10s and a diploma is to be given for the pattern adjudged to be best in the class C competition.

An encouraging feature is the keenness with which leading firms are showing interest in this matter. Some of the largest concerns have written to the executive committee asking to be furnished with the details of competitions, in order that they may be placed before their employes. Considerable liberality is being shown in connection with the prize fund, and although the value of the individual prizes has been increased, ample funds will be available for meeting all requirements.

Cupola Bridges Across Above the Tuyeres

Question: We melt 60 per cent scrap and 40 per cent pig iron in a cupola lined to 30 inches. We use 72-hour foundry coke of the following analysis: Carbon 90 per cent; ash 0.7 per cent and sulphur 0.65 per cent. Our positive pressure blower is set to deliver blast at a pressure of 12 ounces. Shortly after the iron commences to melt a bridge forms above the tuyeres through which the iron comes hot but very slowly. On heavy heats melting ceases entirely before the last charges come down. We have tried changing the bed up and down from 22 to 36 inches above the tuyeres and we also have raised the blast pressure on occasion to 16 inches, but the results are the same. The cupola has been in use for 15 years and it is only during the past year that this trouble has manifested itself.

Answer: Several factors may be responsible for your cupola bridging above the tuyeres, but the most probable cause is that your charges of coke—and possibly iron—are too heavy. 1000-pound iron charges are not excessive for a 30-inch cupola provided all the other factors are working properly; but smaller charges are more easily controlled and usually give better satisfaction. The fact that the cupola gave no trouble for 15 years would seem to indicate that recent practice must be radically different from that pursued heretofore. It may be that your cupola tender has taken it upon himself to change the coke ratio without the formality of consulting any person. It is not unusual to trace many seemingly mysterious cupola troubles to a source of that character. Too much coke between the charges will hold the iron above the melting zone too long. A cold area develops which catches the slag as it drops and freezes it; gradually the bridge extends across the cupola and melting ceases. The proper preventive measure to adopt is to proportion the coke so nicely that by the time each charge of iron is melted the coke charge underneath is completely consumed. For the same reason the weight of the iron charge should be proportioned to the diameter of the cupola so that too much time, relatively, is not required to melt it.

In your case, before trying a lighter charge, we should suggest that you have the cupola charged either under your personal supervision or that of some other person who is both competent and trustworthy. After the bottom is made up put in the wood and coke, approximately 400 pounds, light the fire and after the coke has burned through properly, shovel in the remainder of the bed coke, enough to bring the top of the bed about 30 inches above the top of the tuyeres. Then charge 400 pounds of pig iron and on top of it 600 pounds of scrap. Throw in 5 or 6 forkfuls of coke on top of the iron. The ordinary coke fork holds about 25 pounds of coke and that will give a ratio of about 1 to 8. Later this may be modified if circumstances seem to warrant. However, 1 to 8 represents fairly good practice, especially on a small cupola. The succeeding charges are made up in a similar manner until sufficient has been charged to pour all the castings comprising the day's work. On short heats, say up to 3 tons, no slagging is necessary, but beyond that point it is necessary to slag the cupola to keep it clean. Limestone, 100 pounds to a charge, is placed on top of the coke in each charge commencing with the second or third, and continuing throughout the duration of the heat. In the event that iron produced under these conditions is not hot enough for your work, then you must reduce the weight of both your iron and coke charges. Start with 500 pounds of iron, broken small, and 60 or 70 pounds of coke between charges and gradually increase the amount from day to day until you begin to notice the temperature falling off. A pressure of 12 ounces is too stiff, 10 ounces being sufficient.

The western office of the Quigley Furnace Specialties Co., New York, has been removed to 9 South Clinton street, Chicago.

Foundries Are Moving to New Jersey

That the metals industries, which collectively are the largest employer of labor in New York and surrounded territory, are showing a marked tendency to move from Manhattan and Brooklyn into New Jersey and Queens,' is disclosed in the report of a survey made by the committee on regional plan on New York and its environs. The report shows that at present only five iron foundries are located on Manhattan Island, whereas at one time there were 65. In 1900 there were 35 large metal plants producing heavy and bulky products on Manhattan south of Canal street, and in 1922 there were only 12 such plants in this area. The metal industry in New Jersey continued to grow steadily after the war, while other sections of the area, except Queens, suffered declines. New Jersey is absorbing the major part of the natural growth of the industry and also attracts plants from other localities.

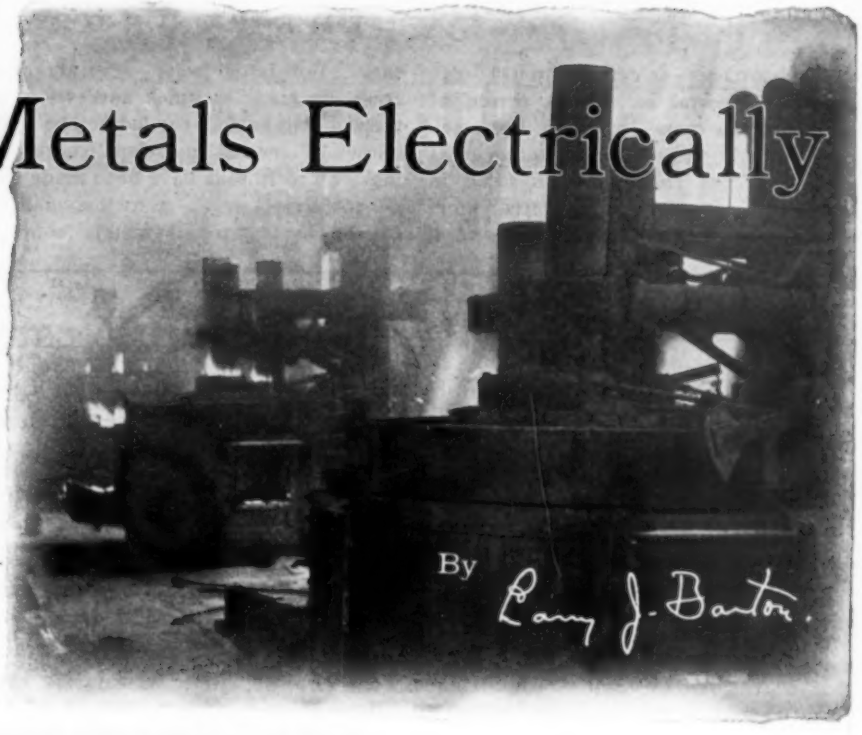
The economic survey is being made by a corps of field investigators under the direction of Robert Murray Haig and Roswell C. McCrea, professors of business economics at Columbia university. The report on the metal industry was prepared by Vincent W. Lanfear, assistant professor of economics, Yale university. Copies of the report may be obtained from the Committee on Regional Plan of New York and Its Environs, 130 East Twenty-second street, New York.

Consider Standardization

In a paper presented recently before the American Society of Agricultural Engineers, E. A. Johnston, director of engineering, and O. B. Zimmerman, assistant manager, experimental and engineering department, International Harvester Co., Chicago, discussed "Intra-Company Standardization and Its Relation to General Standardization." The speakers told of the efforts toward standardization that have been made by the International Harvester Co. That company was formed by the uniting of several companies manufacturing similar lines, each with its individual problems, and with the formation of that company considerable work toward standardization was required.

The Buffalo Forge Co., Buffalo opened a new office at Seattle on June 1. The territory of this office will include the states of Oregon, Idaho, Montana, Washington and also the territory of Alaska. Arthur T. Forsyth of the Buffalo plant will be in charge of the new office.

Refining Metals Electrically



Chapter I

Comparing Units — How Power Charges Are Computed and Applied

SINCE Siemans first applied the electric arc to melting metals, the use of such furnaces has increased slowly but gradually. The first commercial applications of any importance were made about the years 1906 to 1909 when electric furnace steel first was produced in France and Germany. In 1906 the first furnace devoted to steel castings was placed in operation in this country. In 1913 Germany produced more than one half of the world's electric steel, but in 1917 the United States attained the leadership and continues to hold it. Extensive expansion resulted from war time conditions, the electric furnace offering great possibilities in the production of ordnance materials. Since the armistice there has been a gradual change and the greatest application of electric furnaces has been found to be in the production of castings. While the increase in demand for electric steel ingots has been rapid, the great majority of new installations have been placed in service in foundries, many of them replacing converters.

Conditions Govern Change

Analysis of existing conditions explains this rapid increase. During the past few years, the specifications for steel castings have been tightened. This has been a point in favoring electric furnace operations. Then too, there has been a change from cast iron to steel on many types of small castings, especially for car work. These factors made it more difficult for the open-hearth shops where it is impossible to obtain the high temperatures reached in electric furnaces. Another feature is the increased use of high-test gray iron and alloy steel castings which may be handled economically in electric furnaces.

A comparison of the different processes of making steel for castings will better show where the electric furnace attains its popularity. The output of electric steel and the increase in electric furnaces are evident from Tables I, II and III.

In making crucible steel high grade selected scrap metal is placed in a graphite crucible together with the necessary alloys to give a steel of the desired composition. This crucible is lowered into a pot furnace where the heat usually is obtained from a coke fire. The metal is melted, held a sufficient length of time to become thoroughly *killed* or freed from gas. The slag is then skimmed from the metal and it is poured either singly or several crucibles may be poured at one time by using a ladle. Crucible steel from the quality standpoint cannot be excelled, but when it is considered that each pot holds only 80 or 100 pounds of metal it is easy to see that the cost of producing castings by this method is excessive.

Open-Hearth Tonnage Large

The open-hearth furnace usually handles metal in amounts of over 15 or 20 tons at a heat. Under these conditions it is necessary to have a large tonnage of work always on the floor. As such a furnace will pour from three to five heats in 24 hours, and will not run intermittently in an economical manner, a heavy outlay in miscellaneous equipment is necessary to handle adequately such tonnages. Due to physical limitations there is a certain point above which the metal cannot be heated. This makes it difficult to pour small or intricate castings from open-hearth steel. Due to the sizes of individual heats it is impossible to accept orders for small tonnages of special analysis. However, the open-hearth furnace will turn out metal of acceptable quality at a low price, which gives it an advantage and forestalls competition, especially on heavy work where the margin of profit is low. Under ordinary conditions the electric furnace cannot compete with the open-hearth on a price basis.

Before the advent of the small electric furnace in the foundry business, the great majority of steel casting shops, especially the smaller ones, used the side blow converter for producing their metal. This equipment has several dis-

Practical Data

PROBLEMS which concern the metallurgy of electric furnace steel and those relating to general features of melting practice already have been discussed at length. Much has been published that is of importance along these lines. The accompanying article is the first of a series written for operating executives and managers of electrically equipped foundries from the standpoint of a practical man. The subject is presented in such a way that those unacquainted with electric furnace practice may study it and familiarize themselves with the points they should know if the installation of electrical melting units is considered. The general types are cited. Costs, efficiency, size of unit required and other factors are analyzed from the users' standpoint. The writer draws upon his own experience and the reports of others for suggestions as to furnace sizes, maintenance and renewal items, types of linings, and practical control features which assure economical operation with satisfactory metallurgical results. In the first installment, electrical melting is contrasted with other and earlier methods of producing steel for castings. In the second article, which will appear in an early issue, he suggests primary considerations which should govern the selection of an electric furnace.

tinct advantages—it can turn out a large tonnage of metal in a short period of time, and can make extremely hot steel. Consequently the converter found great use where the castings were small in size, and as it could be operated intermittently was generally used for several sary. For large heats several blows could be made in quick succession, the metal being held in the ladle. The writer knows of several instances where castings of 8 to 10 tons have been made from a 2 ton converter. Due to the small size of the heats, special metals could be metal, and quality—the electric furnace has amply demonstrated its superiority. These two points are greatly discussed. The makers of converters deny both of these contentions, but experience has shown them to be true. The best proof of the electric furnace favor is the ever

Writer Was Trained in Western Foundries

HISTORY, romance and even the writings of precise and methodical science are no more than the reflections of man's life and effort. The tropical tempest portrayed by a Conrad or McFee, England's dark days through 1917 as drawn by Walter H. Page, and an abstruse discussion of spectrum analysis partake in like degree of one quality. They represent human experience. To know the writer often adds to an appreciation of his work, for from the writer's life and personality comes a background that sets forth the high lights of his work. Larry J. Barton who has written a complete, practical and interesting series of electric furnace articles of which this is the first, has crowded into his comparatively few years of industrial life, a wealth of experience, all tending toward one end, and all bearing directly upon the subject matter of his writing. A brief summary of his life follows:

LARRY J. BARTON was born in San Francisco, May 21, 1892. He attended the public schools in that city and San Mateo, Cal., was graduated from the high school in San Mateo and entered Leland Stanford university, Palo Alto, Cal., where he completed a five-year course in chemical engineering.

After finishing his college work, Mr. Barton went to work for the Noble Electric Steel Co., Heroult, Cal., a small plant far up in the mountains and one of the earliest to attempt ferroalloy smelting and the production of electric furnace pig iron. The chief chemist and superintendent left this plant on short notice and Mr. Barton was in charge temporarily, later being made chief chemist and assistant superintendent when a new executive was sent out to take charge. At this time the plant was working full time making ferromanganese and ferrosilicon to meet the early war demand.

When the United States entered the war, Mr. Barton volunteered, entering the army as a private, and later qualifying through examination for a lieutenant commission, when he was assigned to the proving ground at Aberdeen, Md. working on gun and general steel inspection. With the close of the war, he obtained a position with the American Manganese Steel Co. then erecting its new plant at Oakland, Cal. Mr. Barton directed the installation of all equipment including a 3-ton heroult furnace, and when the plant was ready for operation he was given control of the metallurgical work. He remained with this firm until the early part of 1920, when he was placed in charge of a new electric steel foundry built by the Southern Pacific Co. at Sacramento, Cal. This plant soon was operating on a 24-hour basis, making steel ingots at night and castings during the day, for railway service.

During his service with the Southern Pacific railway foundry, Mr. Barton conducted experiments on synthetic pig iron, producing a considerable tonnage of this metal, some of which was made into ingot molds in the foundry.

In June, 1922, a small foundry in Los Angeles made Mr. Barton an offer to take charge of the shop and to run experimental work on electric furnace gray iron, including special white irons to resist abrasion. This venture proved unsatisfactory, although he was successful in making the kinds of metal sought, so after only three months, he decided to return to production work and accepted a position with Dibert, Bancroft & Ross Co., New Orleans.

He entered the employ of that company in November, 1922, having charge of the metallurgical work of the entire plant and direction of the steel foundry where a 3-ton electric furnace is in operation. At present Mr. Barton continues his connection with the New Orleans company, which makes railway steel castings and sugar mill machinery, but devotes a portion of his time to consulting engineering practice.

The Editors.

blows on alternate days. Where the output was such that a greater quantity of metal was necessary, another converter could be installed for auxiliary service. A 2 ton converter will blow a heat in approximately 20 minutes, giving an exceptional tonnage when neces- made by alloying in the ladle or converter. Until the last few years, all of the manganese steel used was produced in this manner.

Consequently the converter offers keen competition to the electric furnace. However, in two main points—cost of molten increasing number of substitutions of electric furnaces for converters.

In THE FOUNDRY for Feb. 1, 1920 is an interesting and important comparison of the two methods of melting as practiced at the Taylor-Wharton Iron & Steel Co., described by Messrs. John H.

TABLE I

Comparative Output of Electric Steel*

	1913	1917	1918	1919	1920	1921
United States	30,180	304,543	511,364	384,452	502,152	169,499
Germany	88,256	219,700	240,037	55,382	.....	.....
Great Britain	None	98,592	115,448	77,000	89,100	27,100
Canada	None	59,467	119,130	15,502	28,301	16,844
Austria-Hungary	26,387	47,152	41,163	.....	.....	.....
France	21,124	54,031	58,222	42,559	58,080	24,457
Italy	.....	36,948	40,000**	89,000	100,000**	140,000
Sweden	2,276	10,664	15,000**	.....	.....	.....
Total	168,673	822,097	1,140,364	663,895	777,633	377,900

**Estimated.
*Edwin F. Cone, *Iron Age*, Sept. 14, 1922.

TABLE II

United States Production*

	Total electric steel ingots and castings	Electric steel castings	Alloy steel castings
1913	30,180	9,207	443
1916	168,918	42,870	926
1918	511,364	108,296	3,074
1920	502,152	155,196	11,710
1921	169,499	85,095	10,084
1922	346,039	154,982	17,760

*Annual Statistical Report American Iron and Steel institute.

Hall and G. R. Hanks. They state the following conclusions:

"At our High Bridge plant we have a 3-ton, heroult electric furnace and a 3-ton, bottom-blow, bessemer converter working side by side. The electric furnace is operated on a basic bottom, which enables us to turn out a steel low in phosphorus and sulphur.

"During the war we had orders for castings for the army and navy, and to use the converter for this class of work we installed the Stoughton oil burning process in our cupolas, by which we were enabled to turn out steel sufficiently low in sulphur to meet the government's specifications and in many cases to get sulphur considerably below 0.06 per cent.

"We had always been able to meet the tensile tests for Classes 1, 2 and 3 army and navy A, B, C, and D steel with converter metal and after we had the oil working successfully on the cupola we undertook to turn our army and navy work with the converter as well as with electric steel.

"We had not gone far with the more intricate castings before we were faced with the fact that the converter steel, even when the sulphur was around 0.05 per cent, was much more subject to hot cracks and tears than the electric steel and apparently it was not always true that the lower sulphur heats were any better in this respect than the high sulphur heats.

"To throw some light on this question we kept careful records on one of the cradle-band castings for a 240 millimeter howitzer. These castings were of Class 3 steel, but in our practice we poured them with steel running from 0.25 to 0.35 per cent carbon and we secured the desired tensile strength by heat treatment. The accompanying Table IV gives the analyses of a number of converter and electric heats from which castings of this pattern were poured and shows clearly the large percentage of cracked and torn castings on the converter steel. An examination of this table will show that in the converter heats on which no castings were lost the sulphur was as high or higher than on the heats on which castings were rejected for hot cracks. It will also be noted that at least one of the electric furnace heats, 1 (A), is not low in sulphur and on this heat we lost no castings. In fact electric heat 1 (A) with 0.032 per cent sulphur is directly comparable with converter heat number 1 (B) with 0.038 per cent sulphur, on which a casting cracked.

"In our efforts to overcome the hot tears in the foundry we used all of the *stunts* that could be worked out with any reasonable theory behind them, and some of them were as follows: The castings were made both in green and dry sand; they were taken out of the molds hot; were allowed to cool over night, etc. Some of these same molds were relieved to allow free shrinkage by destroying the sand grip, while others merely had the cope lifted and were allowed to remain until cold. During our experiments we determined that the castings poured from electric steel could be handled in any manner that time and equipment would allow, and our results produced few rejections, whereas with castings poured from converter steel we were unable to produce any large proportion of good castings regardless of the manner in which they were cared for.

Table IV

Data on Electric and Converter Heats

No. of cast	E or C	Carbon	Manganese	Sulphur	Phosphorus	Phosphorus	Rermarks
1(A)	E	0.28	0.24	0.47	0.032	0.023	
4	E	0.34	0.51	1.40	0.014	0.040	
1	E	0.35	0.24	1.00	0.017	0.037	
3	C	0.30	....	0.87	0.047	0.049	2 cracked
2	C	0.29	0.47	1.11	0.046	0.050	1 cracked
2	C	0.27	0.56	0.84	0.065	0.041	1 cracked
1	C	0.30	....	1.13	0.055	0.043	1 cracked
2	C	0.26	....	0.98	0.057	0.049	1 cracked
1	C	0.27	0.38	1.00	0.070	0.045	
2	C	0.24	....	0.80	0.064	0.040	1 cracked
3	E	0.27	0.19	1.31	0.016	0.020	
2	C	0.28	0.56	1.07	0.065	0.043	
1	C	0.26	0.61	0.94	0.055	0.048	
5	E	0.31	0.33	1.00	0.015	0.027	
1	E	0.35	0.20	1.00	0.018	0.031	
3	E	0.30	0.28	0.93	0.014	0.020	
2	C	0.33	0.38	0.94	0.054	0.047	2 cracked
1(B)	C	0.28	.. .	0.88	0.038	0.045	1 cracked

"Somewhat later we undertook the manufacture of rudder stocks and stern frames for merchant ships, and our experiences on these castings were even more illuminating than on the smaller castings for ordnance work. The reason for this was that the castings were so long as to give a very great total shrinkage amounting to 5 inches. Our first really conclusive test on these castings came when we were obliged to pour a rudder stock from two heats of converter steel which analyzed as follows: Carbon 0.29 to 0.31 per cent, silicon 0.51 per cent, manganese 0.77 to 1.01 per cent, sulphur 0.057 to 0.066 per cent and

Table III

Electric Steel Furnaces in United States and Canada*

Make of furnace	Jan. 1923	1922	1921	1920	1918	Make of furnace	Jan. 1923	1922	1921	1920	1918
Heroult	181	179	177	170	146	Gronwall-Dixon	12	12	12	13	12
'Lectromelt	53	36	24	20	4	Booth	10	14	14	12	4
Snyder	53	54	54	49	35	Girod	5	5	5	5	5
Greaves-Etchell	28	28	25	18	12	Vom Baur	5	6	5	4	0
Greene	27	23	18	11	1	Webb	2	2	2	2	2
Rennerfelt	18	18	17	18	13	Swindell	2	..	..	..	..
Ludlum	14	13	13	12	6	Miscellaneous	27	29	21	25	25
Volta	13	13	8	..	..	Total	456	438	399	363	269

*Edwin F. Cone, *Iron Age*, Jan. 4, 1923.

Table V

New Orleans Contract Terms

DEMAND CHARGE

	Kilowatt-hour
First 5 Kilowatt hours of demand	$3.00
Next 15 Kilowatt hours of demand	2.50
Next 30 Kilowatt hours of demand	2.25
Next 150 Kilowatt hours of demand	2.00
All over this amount	1.50

ENERGY CHARGE

	Cents per Kilowatt-hour
First 500 kilowatt hours	5.0
Next 1000 kilowatt hours	3.0
Next 3500 kilowatt hours	2.5
Next 45,000 kilowatt hours	1.0
All over 50,000	0.75

FUEL CHARGE

A sliding scale based upon the price of coal, which cannot exceed 30 per cent of the calculated energy cost.

DISCOUNTS

Ten per cent off for ten day payment on total bill.

Ten per cent on energy charge for company owning their own high tension transformers.

Fifty per cent off of demand charge if no current is used during peak hours, this period being the time between five and seven p.m.

Fig. 2 shows power costs per ton of metal, based upon this schedule.

Table VI

Pittsburgh District Contracts*

PRIMARY OR DEMAND CHARGE

	Cost per Kilowatt
First 25 per cent of maximum demand	$4.00
Next 25 per cent of maximum demand	3.00
Next 50 per cent of maximum demand	2.00
Kilowatt in excess of 1200	1.00

SECONDARY OR ENERGY CHARGE

	Cents per Kilowatt-hour
First 50,000 kilowatt hours	0.9
Next 50,000 kilowatt hours	0.85
All over 100,000	0.75

DISCOUNT

From the secondary charge a discount of 0.005 cents per kilowatt-hour is made on the first 100,000 kilowatt hours for prompt payment.

Fig. 3 shows actual metal costs based on this schedule.

* "Electric furnace power from the central station standpoint." E. A. Wilcox, American Electrochemical society, April 1920.

phosphorus 0.052 to 0.056 per cent. The result was the casting tearing in three pieces. This casting was poured the same day successfully from electric metal."

The experience of these people are similar to others throughout the country, that is electric furnace metal of a similar analysis will give good castings where converter metal is more likely to crack and tear.

The prospective purchaser of an electric furnace is interested in the qualifications and limitations of such a melting medium. Often his foundry is at present equipped with a converter or a small open hearth, and he is not anxious to make a change unless future results will warrant the added expense. In general, the electric furnace offers many points of superiority over other types of steel making equipment. However, like everything else, it has certain limitations.

The most important point is that of quality. Due to the absence of any gaseous matter being blown into the furnace, the steel can be *killed*, readily assuring sound castings. Metal of regular composition is obtained. The temperature is always under exact control, and may be made high enough to run castings of the thinnest sections. As small heats can be taken off at short intervals, the amount of floor space required, and the number of flasks and other miscellaneous appurtenances is kept at a minimum. For these reasons losses in defective work is lower than in any other process of manufacture.

John A. Matthews,[1] president of the Halcomb Steel Co., pioneer in electric steel manufacture, presents a summary of the merits of this metal. These are:

1. The chemical composition of consecutive heats, most notable when handling easily oxidized metals like vanadium, chromium, silicon and manganese, can be held more closely to a standard than with any other process.

2. To insure a given final medium, less of these metals need be added, hence there will be less of the oxides of these metals produced in the steel and less to be removed.

3. Heat treating is improved according as composition can be controlled closely.

4. Electric steel usually is more near-

1 Analysis of electric steel making as presented at Detroit meeting of American Electrochemical Society, May 2-5, 1917.

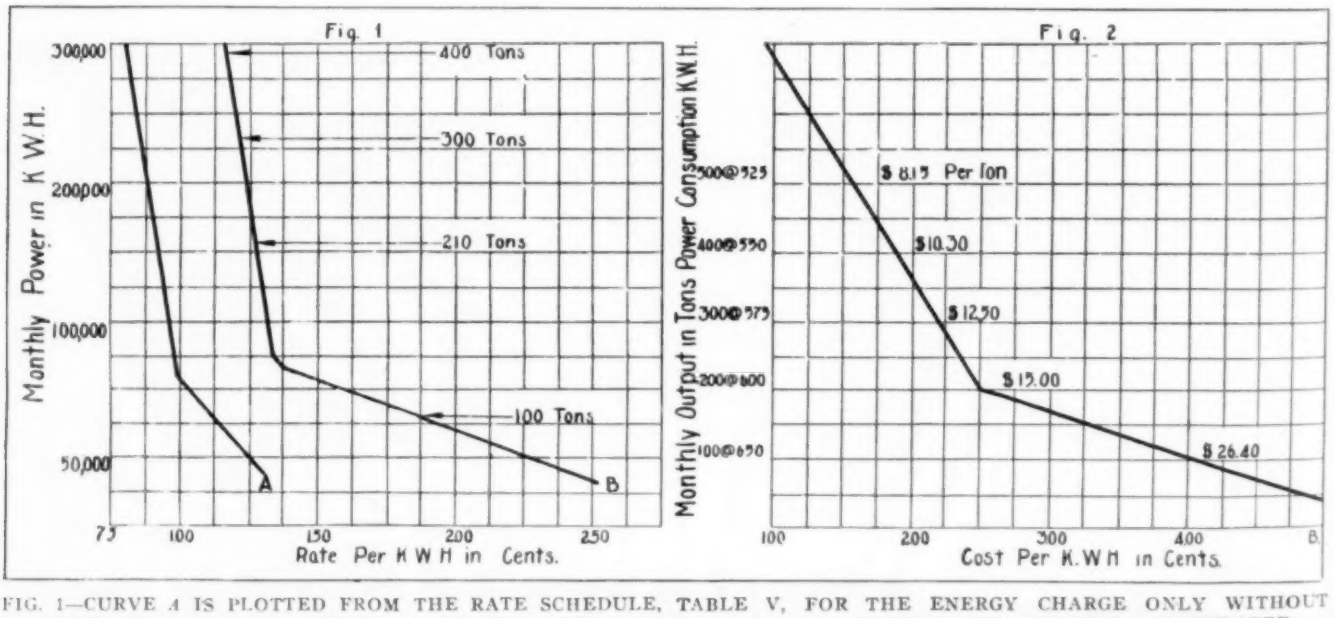


FIG. 1—CURVE *A* IS PLOTTED FROM THE RATE SCHEDULE, TABLE V, FOR THE ENERGY CHARGE ONLY WITHOUT ADDED FUEL CHARGE—CURVE *B* IS PLOTTED FROM ACTUAL COSTS OF ENERGY AND COMPRISES CALCULATED COST PLUS THE ADDED FIGURE FOR FUEL—NOTE THE GREAT DIFFERENCE CAUSED BY THIS SMALL ITEM FIG. 2.—ACTUAL COSTS FOR TOTAL POWER, INCLUDING DEMAND, ENERGY AND FUEL CHARGE BASED UPON ACTUAL COSTS

Table VII

East Power Contract

Eastern power contract* available to customers with connected load of 200 kilowatt hours or more.

DEMAND CHARGE

	Per kilowatt per month
First 200 kilowatts	$1.50
Next 800	1.00
All over 1000	0.75

ENERGY CHARGE

	Cents per kilowatt hour
First 10,000 kilowatt hours per month	1.5
Next 90,000	1.0
Next 200,000	0.8
All over 300,000	0.6

REMARKS

Demand determined by averaging 30 minute peaks for first month, this rate to hold for remaining 11 months unless demand is increased.

Five per cent off for prompt payment. No discounts for off peak use of power

*E. A. Wilcox.

ly chemically pure than any other steel. Irrespective of whether or not uniformly distributed sulphur is as harmful as is generally believed, it is obvious that the segregation of elements is impossible if they are absent. It also follows that if the segregation of sulphur and phosphorus is not to be feared the percentage of cropping may be reduced and the yield of sound metal increased.

5. Low sulphur in electric steel usually indicates a prior reducing condition favorable to complete deoxidations, sound ingots, freedom from blowholes and resulting seams. Quiet metal has less tendency to segregate in the mold, in respect to either metallic or nonmetallic elements and produces metal free from laminations.

6. Alloy additions may be made in the furnace itself rather than in the ladle which increases the probability of thorough assimilations, diffusion and homogeneity.

7. Results indicate that electric steel is less injured by overheating than other steels. It has a wider range of heat treatment and will stand variations in forging and following treatment without injury.

8. Electric steels usually are freer from slag and nonmetallic inclusions than bessemer or open hearth steels.

9. The foregoing characteristics tend toward the production of a steel of better quality. The electric furnace possesses an economic value in its adaptability to the recovery of scrap values, and has a decided advantage over the open hearth furnace in that some alloy scraps do not make desirable additions to open hearth furnaces, or if such additions are made, usually result in a great deal of the scrap metal being lost in the slag. With the widespread and increasing use of alloy it is highly desirable that alloying elements be not lost when contained in the scrap.

The electric furnace is highly adaptable, a feature which is of the greatest importance, and one finding increased use daily. A heat of plain steel may be poured followed by a heat of gray or white iron, or some alloy mix. Consequently, a shop is enabled to bid on a greater variety of work, thus obtaining a greater aggregate tonnage than the one product company. The writer has known several companies which regularly handle five or six different classes of metal from the same furnace with no difficulty.

The main point at issue in discussing a contemplated electric furnace installation is the cost of the molten metal at the spout, and it is this feature which settles the argument. If electric furnace metal is going to be too costly it is unwise even to consider such a melting medium, unless the product is of such a character that a few dollars' difference in cost of molten metal may be disregarded. For general foundry work extreme quality is not of enough importance to outweigh this cost of metal.

Electric power is the deciding factor

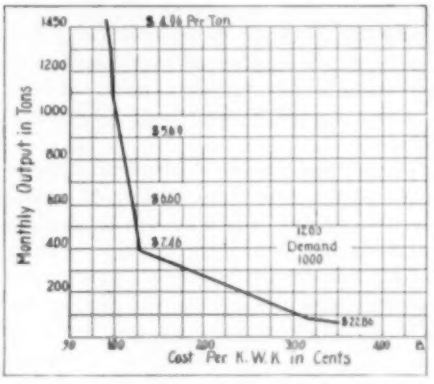


FIG. 3—ACTUAL COSTS PER TON FOR POWER UNDER THE SCHEDULE AS DESCRIBED IN TABLE V.

when considering the costs of steel. The cost of this energy varies greatly, being cheap in sections where hydroelectric power predominates, and comparatively high in sections of the country where electric current is produced by steam. Electric current usually is sold under some sort of a sliding scale, and comprises two charges, that for demand, and the energy charge for current actually consumed. The demand charge is fixed monthly and is determined by the maximum amount of current called for at any one time during the period. The energy charge changes according to the total amount of current used in the month. Then there are other clauses covering service in off peak hours; certain clauses covering changes in price of coal, etc. The prospective consumer should understand thoroughly all the details of his contract as a fraction of a cent's difference may mean several dollars a ton on the finished product.

The accompanying Tables V, VI and VII show different types of power contracts in force in various sections of the country and are typical. Note partic-

TABLE VIII

Great Western Power Co. Contract

SERVICE:

This schedule applies in the entire territory served except in standard voltage of 2200 volts or over.

TERRITORY:

This schedule applies in the entire territory served except in Butte and Plumas County.

RATE (A):

Service at 2200 volts up to and including 25,000 volts.

DEMAND CHARGE

First 200 kilowatts or less of maximum demand $300 per month.

Next 200 kilowatts of maximum demand $1.00 per kilowatt per month.

Next 500 kilowatts of maximum demand 75 cents per kilowatt per month.

All over 1000 kilowatts of maximum demand 60 cents per kilowatt per month.

ENERGY CHARGE

First 150 kilowatt hours per kilowatt per month, 8 cents per kilowatt hour.

Next 250 kilowatt hours per kilowatt per month, 6 cents per kilowatt hour.

All over 400 kilowatt hours per kilowatt per month, 55 cents per kilowatt hour.

RATE (B):

Service at line voltages in excess of 25,000 volts.

The rate is the same as that set forth under Rate (A) above decreased by 10 per cent.

SPECIAL CONDITIONS:

(A) Total Charge

The total charge is the sum of the demand and energy charges given above.

(B) Voltage

Service under Rate (A) will be supplied by the company at standard voltages of 2200 volts or more up to and including 25,000 volts as requested by consumer.

Service under Rate (B) will be supplied by the company from standard line voltages as available above 25,000 volts.

(c) *Demand*

The maximum demand in any month will be the average kilowatt delivery of the 30 minute interval in which the consumption of electric energy is greater than in any other 30 minute interval in the month. The maximum demand on which the demand charge and energy block will be based will not be less than 50 per cent of the greatest maximum demand occurring during the 11 preceding months.

Any demand occurring between the hours of 11 p. m. and 6 a. m. of the following day will not be considered in the determination of the above demand charge.

(d) All voltages referred to in this schedule are nominal voltages.

TERMS AND CONDITIONS

See preliminary statement, application and contract forms and rules and regulations.

ularly the curve accompanying Table V. With this contract as shown the added charge based on price of coal amounts to 0.325 cents per kilowatt hour, or approximately $3.25 per ton of clean castings.

From these varying power schedules some comparison may be had of actual electric energy costs, and the various methods of placing the charges. Each installation usually requires a new power contract with the supplying company unless there are already electric furnaces on the companys' line, when a similar contract may apply to the new installation.

Under nearly all schedules a heavy discount is allowed when power is taken in *off peak* periods and naturally it is to the benefit of the foundry to operate in these hours if possible. This usually is accomplished by molding during daylight and pouring all work at night when the off peak hours fall at night. To do this certain concessions such as higher wages must be paid to the furnace and miscellaneous labor. The only objection to this is that a greater amount of floor space is required, and the number of flasks necessary is increased. This tends to detract from one of the main advantages of the electric furnace. This issue must be carefully thought out and preferance given to the arrangement offering the cheapest operation.

When the off peak period is short it is possible to arrange heats so that the furnace will not be used at times when the load is heaviest.

Another point of importance, epsecially in the new shop where tonnages are low for the first few months, is that of demand. As this is a fixed charge regardless of how much energy is used, and its final cost is directly proportional to the tonnage, it is important to keep as low a demand figure as possible. This will mean keeping down the power input to the furnace, and will result in the heats taking a slightly longer time.

Reference to Table V will illustrate this point. This power schedule has a sliding demand charge, and was drawn up to apply on the operations of a 3-ton acid furnace the normal capacity of which was 1500 kilowatts. During the first two months operation, the tonnages were approximately 25 for each month. The demand was kept down to 1200 kilowatts costing $850 or about $34 per ton. As business increased and it became necessary to make quicker heats, the furnace was allowed to draw a heavier load and the demand went up to 1600 kilowatts costing $1150 or $5.75 per ton based on the output of 200 tons obtained. If the demand had been set at 1600 from the first it would have resulted in a needless expense of $300 per month.

Pumps Made in Quantities

(*Concluded from Page* 423)

becomes specially skilled in a few operations. Sand for the smaller cores is bonded with an oil binder while a dry, pitch-base binder is employed in the core mixture from which the larger cores are made.

Miscellaneous castings ranging in weight from 25 to 500 pounds are made in green-sand molds on the remainder of the floor area in this bay. A concrete gangway bordered with light rails extends from the coreroom to the far end of the building. The molding floors are located on both sides of the gangway and the various molding machines are stationed close to the columns on one side of the bay and close to the wall of the building on the opposite side. A traveling air hoist is available over each floor for handling the molds and later pouring the iron. Illustrations showing typical features in this bay are shown in Figs. 11 and 12.

The molds shown to the left in Fig. 11 are for a small centrifugal pump casing and were made on the power-operated, squeezer, stripping-plate machine shown close to the column in the same illustration. Two patterns are mounted on the plate side by side and arranged along a center line in such a manner that both halves of the mold may be rammed alternately on the same plate. These molds and others are made in an open grade of sand that is worked dry and rammed much harder than is customary in the average green sand foundry. The density of the sand may be gaged from the fact that the copes are not provided with bars and no weights are placed on top before the iron is poured in the molds. Flasks up to 20 x 24 inches with 10-inch cope and drag are not equipped with bars. Over that size, bars are employed sparingly.

Cleaning Facilities

Castings are cleaned in two adequately equipped departments located outside and close to each end of the foundry building as shown in the plan view Fig. 3. The room at the right is reserved for the heavier castings that enter into the construction of the power driven pumps. The castings are sandblasted with equipment supplied by the Pangborn Corp., Hagerstown, Md., and afterward ground and chipped with suitable pneumatic equipment.

Castings for the hand pumps are cleaned in a battery of 16 tumbling barrels located in a double row near the center of the building shown to the left. After leaving the tumbling barrels the cleaning process is finished on a battery of six, double-stand, grinding wheels. The company maintains a pattern shop where wood and metal patterns are made, changed and repaired. While many pumps are standardized, still conditions involve changes in minor particulars from time to time. In many lines the designing force constantly is investigating new principles and new application of old principles, with the result that a full force of patternmakers is kept working to capacity.

Lays New Screw Threads on Meat Chopper

Question: I shall appreciate any information you can furnish on how to make a pattern for a screw similar to those employed in meat choppers. Is there any rule for laying out the thread?

Answer: So far as we know the thread on one of these screws is laid out according to the personal whim of the designer. It is not a true mechanical thread and therefore cannot be developed. You probably have noted that it is not even a continuous thread. Usually an extra half turn is provided between the two narrow threads close to the cutters. The thread then opens to form a hopper for the reception of the material to be ground. The pitch is not uniform at any two points and neither does it accelerate evenly. You probably are familiar with the method of laying out a true screw by drawing diagonal lines on a sheet of paper to represent the pitch and the face of the thread and then transferring these lines to a prepared cylindrical wood block by wrapping the paper around it. The idea might be adopted by drawing lines corresponding with the width of threads you desired instead of the evenly spaced lines required for a true screw. The pattern of course is formed in halves to be molded one half in the drag and one-half in the cope. Additional liberties are taken with the screw on that account to provide generous draft allowance so that the pattern will leave the sand easily. Several books on patternmaking are available. We suggest you procure a copy of *Patternmaking*, by Joseph A. Shelly, which may be ordered through THE FOUNDRY for $3.00.

Lime specifications for silica brick together with a brief description of the way in which lime is used in the manufacture of the brick, are embodied in circular 153 of the United States department of commerce, bureau of standards, entitled "Recommended Specifications for Quickline and Hydrated Lime in the Manufacture of Silica Brick". Complete directions for sampling and testing also are given.

Simplifying Cupola Mixtures

Chemical Composition of the Pig Irons Used Should Closely Parallel That for Castings Required—Uniform Amounts Used in Cupola Mixture Produce a More Even Product

BY GEORGE A. DRYSDALE

THE assertion often has been made that all pig irons are good irons. This is true insofar as they are used to the best advantage in obtaining satisfactory results when melted in a cupola furnace. The most suitable pig irons to be used are those with chemical compositions similar to the castings required when the propotrions used in the mixture are as uniform as possible and extremes are avoided.

Tables I and II give two cupola mixtures for medium machinery castings carrying 50 and 45 per cent of scrap. The required chemical composition of the castings is: Silicon, 2.00; sulphur, not over 0.085; phosphorus, 0.50 and manganese, 0.50 per cent. In the first mixture it will be noted that the proportion of the metalloids given for irons *A* and *B* are similar to those required in the casting. In figuring the silicon content of these two irons with return scrap in the proportions as given in the table, the total theoretical amount of silicon will be 2.11 per cent, and allowing 0.10 per cent for oxidation in melting, the theoretical amount of silicon in the casting will be 2.01 per cent, the amount required. In the second mixture, Table II composed of pig irons *C* and *D*, carrying 25 per cent home scrap and 20 per cent foreign scrap, the amounts are relatively in good proportion.

Makes Uniform Castings

The advantages to be derived from such mixtures are that the resultant castings are uniform and any mistakes made in weighing and charging the pig iron and scrap will not affect the product materially. The castings will not be so extremely hard or soft as to necessitate their being rejected.

The following is a good example of the uniformity of test bars obtained from cupola mixture No. 1 and poured in six consecutive heats.

Heat No.	Tensile strength pounds per	Transverse strength square inch	Deflection in inches	Per cent silicon in test bar
1	28,740	2,810	0.130	1.935
2	27,960	2,780	0.125	2.006
3	28,280	2,890	0.130	1.971
4	27,640	2,770	0.125	2.050
5	28,040	2,890	0.130	2.087
6	27,560	2,810	0.130	2.015

The test bars used for tensile strength were round in diameter, 1⅛ inches and the test bars for transverse strength were 1 inch square, 13 inches long, 12 inches between knives, with the dead load at the center.

It may be noted that the maximum variation in tensile strength is 1140 pounds. The transverse strength variation is 120 pounds with a deflection of 0.005 inch. The maximum variation of silicon is 0.152 per cent. These figures may be regarded as evidence that charging and melting conditions were satisfactory.

The test bars poured from cupola mixture No. 2 although not as high in strength showed the same uniformity in their physical properties and silicon content. The test results for mixture No. 2, shown in Table II, follow:

Heat No.	Tensile strength pounds per	Transverse strength square inch	Deflection in inches	Per cent silicon in test bar
1	26,840	2,700	0.120	1.970
2	26,270	2,790	0.120	2.020
3	26,935	2,760	0.125	2.056
4	27,370	2,825	0.125	1.956
5	27,480	2,800	0.125	1.897
6	26,880	2,735	0.120	1.928

The difference between the maximum and minimum figures given for tensile strength is 1110 pounds. The variation in transverse strength is 125 pounds with a difference in deflection of 0.005 inch. Variation in silicon content is 0.159 per cent which shows satisfactory conditions. These two mixtures are typical of a number that the author has used during the past few years and also the physical properties as given are typical of the results obtained.

Cupola mixtures Nos. 3 and 4 are of uneven chemical composition and give extremes used for medium machinery castings. In cupola mixture No. 3 attention is called to the small amount of ferrosilicon used. Ferrosilicon in the total of 5 per cent was added as a softener to raise the percentage of silicon in the mixture.

The physical properties and silicon content of six consecutive heats from this mixture are recorded as follows:

Heat No.	Tensile strength pounds per	Transverse strength square inch	Deflection in inches	Per cent silicon in test bar
1	29,200	3,070	0.135	1.786
2	28,000	2,890	0.130	1.829
3	23,250	2,407	0.120	2.240
4	25,500	2,530	0.120	2.237
5	29,460	3,120	0.135	1.746
6	23,280	2,375	0.120	2.159

The maximum variations in the physical properties and silicon content will be noted as follows: Tensile strength, 6210 pounds, transverse strength, 745 pounds with a deflection of 0.015 inch. The silicon content variation is 0.494 or practically ½ of one per cent.

Fluctuations in Silicon

The fluctuations in the physical properties and the percentages of silicon in the test bars are an indication of the unevenness in the castings produced from these heats, and would lead to the conclusion that when these castings were machined some of them would be considered hard and others too soft and weak to be satisfactory.

Mixture No. 4, Table IV, shows a lack of uniformity in the phosphorus and manganese content. Irons *H* and *J* were used to increase the percentages of these elements in the mixture, and although the test bars did not show the wide variation in chemical and phys-

TABLE I

Cupola Mixture No. 1 for Medium Machinery Castings

Pig iron	Per cent silicon	Per cent sulphur	Per cent phosphorus	Per cent manganese	Charge per cent
A.	2.50	0.024	0.66	0.83	25
B.	2.00	0.015	0.54	0.60	25
Home scrap	1.98	0.080	0.55	0.58	50
Average:	2.11	0.049	0.57	0.65	100

TABLE II

Cupola Mixture No. 2 for Medium Machinery Castings

Pig iron	Per cent silicon	Per cent sulphur	Per cent phosphorus	Per cent manganese	Charge per cent
C.	2.40	0.025	0.560	0.635	30
D.	1.86	0.031	0.423	0.842	25
Home scrap	2.00	0.085	0.427	0.584	25
Foreign scrap	2.100	0.085	0.500	0.500	20
Average:	2.100	0.085	0.480	0.647	100

ical properties as given by mixture No. 3, yet it is safer to follow along the lines of mixtures Nos. 1 and 2, where uniformity in the castings is essential. The same rules should apply in making up mixtures for semisteel castings as the steel in itself causes an extreme condition and it is unsafe to go to the other extreme by using a ferro-silicon to raise the percentage of silicon in the mixture.

Tables V and VI give two cupola mixtures for semisteel castings carrying 15 per cent steel scrap. Mixture No. 5 shows an extreme range in silicon and a corresponding lack of uniformity in the percentages of pig iron used. Mixture No. 6 shows a more evenly balanced condition as to the silicon content and proportion used.

Cupola mixture No. 7, Table VII, gives a good example of the use of a larger number of irons than was necessary, and indicates that the amounts used in the mixture were not in good proportion. Cupola mixture No. 8 shows a simplified form using two of the four irons given in mixture No. 7 which makes the proportions used more uniform, and tends to eliminate any confusion in the weighing and handling of so many different grades of iron.

The percentages of combined, and graphitic carbon have not been given in the different mixtures as the average American pig irons are well supplied with carbon, and the two forms are controlled in a great measure by the silicon content and the physical conditions found at the time of pouring.

The use of a mixing ladle eliminates to a great extent the bad effects of uneven melting, but the handling of such a ladle is not always convenient or possible, and if the extremes in the pig irons used in the cupola mixture are avoided its use is not essential to obtain uniform castings.

Choosing foundry pig irons by their physical and chemical properties that are best suited to the purposes required, and in mixing these irons in as uniform a proportion as possible in the cupola furnace, will greatly simplify the control of the iron. Further, the resulting castings will be more uniform in their chemical and physical properties which is a very essential feature.

For safety set a minimum standard of 5 feet for all main gangways along which the ladles must travel.

TABLE III

Cupola Mixture No. 3 for Medium Machinery Castings

Pig iron	Per cent silicon	Per cent sulphur	Per cent phosphorus	Per cent manganese	Charge per cent
E.	9.50	0.015	0.45	0.65	5
F.	2.20	0.045	0.80	0.45	15
G.	1.15	0.025	0.20	1.25	30
Home scrap	2.00	0.085	0.45	0.55	25
Foreign scrap	2.10	0.085	0.50	0.50	25
Average:	2.17	0.057	0.42	0.74	100

Table IV

Cupola Mixture No. 4 for Medium Machinery Castings

Pig iron	Per cent silicon	Per cent sulphur	Per cent phosphorus	Per cent manganese	Charge per cent
H.	2.45	0.045	1.50	0.35	10
I.	2.30	0.021	0.65	0.46	40
J.	2.21	0.047	0.24	2.25	10
Home scrap	2.00	0.090	0.45	0.47	20
Foreign scrap	1.95	0.085	0.50	0.50	20
Average:	2.17	0.052	0.62	0.63	100

TABLE V

Cupola Mixture No. 5 for Medium Semisteel Castings

Pig iron	Per cent silicon	Per cent sulphur	Per cent phosphorus	Per cent manganese	Charge per cent
K.	9.75	0.015	0.45	0.57	5
L.	2.25	0.035	0.58	0.65	40
Home scrap	2.01	0.090	0.47	0.65	40
Steel scrap	0.05	0.045	0.05	0.50	15
Average:	2.19	0.057	0.45	0.60	100

TABLE VI

Cupola Mixture No. 6 for Medium Semisteel Castings

Pig iron	Per cent silicon	Per cent sulphur	Per cent phosphorus	Per cent manganese	Charge per cent
N.	4.20	0.020	0.50	0.65	20
P.	2.25	0.035	0.58	0.60	25
Machine scrap	2.01	0.090	0.48	0.55	40
Steel scrap	0.05	0.045	0.05	0.50	15
Average:	2.21	0.056	0.44	0.60	100

TABLE VII

Cupola Mixture No. 7 for Medium Semisteel Castings

Pig iron	Per cent silicon	Per cent sulphur	Per cent phosphorus	Per cent manganese	Charge per cent
Q.	8.50	0.025	0.61	0.58	5
R.	3.25	0.020	0.57	0.65	20
S.	2.50	0.035	0.49	0.75	10
T.	1.15	0.045	0.20	0.95	20
Home scrap	2.00	0.085	0.35	0.65	30
Steel scrap	0.05	0.045	0.05	0.50	15
Average:	2.18	0.050	0.31	0.69	100

TABLE VIII

Cupola Mixture No. 8 for Medium Semisteel Castings

Pig iron	Per cent silicon	Per cent sulphur	Per cent phosphorus	Per cent manganese	Charge per cent
R.	3.25	0.020	0.57	0.65	25
S.	2.50	0.035	0.49	0.75	30
Home scrap	2.00	0.085	0.35	0.65	30
Steel scrap	0.05	0.045	0.05	0.50	15
Average:	2.17	0.050	0.40	0.66	100

Publishes Unique Booklet

Under the title *Thus and So*, Frederic B. Stevens, Detroit, has added another to the *T* series of publications which has been issued intermittently over a period of many years and which has given foundrymen and others an interesting and personal glimpse of a man who has the courage of his convictions and who writes unconventional copy for his advertisements. Former publications include: *This and That, That and This, This, That and Then, T'other and Which, That, That Is, Is.* The present volume 5 x 7 inches, 80 pages, printed on tinted paper with an attractive illustrated cover is a convenient size to slip into a coat pocket from which it may be rescued for occasional persual. Thriftily yet withall modestly, Mr. Stevens has utilized the pages usually left blank at the beginning and end of a book, to direct attention to the merits of the foundry supplies and equipment handled by his firm. The remainder of the book is devoted to a presentation of the authors views on business in general and with particular reference to the subject of collection letters. He claims that letters may be written that touch the pocketbook without touching the sensibilities of the recipient.

Notes Sand Test Methods--II

Results Obtained With the Sieve Test and the Elutriator Compared With Special Reference to the Distribution of Bond—Selecting and Standardizing Tests

BY C. W. H. HOLMES

BEFORE considering the venting properties of molding sands, the fact that permeability and porosity are two essentially different things must be appreciated. A substance is only permeable when gases can pass through it. A substance is porous when it contains cavities, and the ratio of the volume occupied by these cavities to the total volume is known as the porosity. If a substance is permeable it must be porous, but the converse is not true. For example, a piece of coke may have a porosity of 40 per cent and yet any effort to pass gas through it would result in utter failure; in other words it is impermeable.

Further if we took samples of clean sand with rounded grains 1 millimeter, 0.25 millimeters, 0.05 millimeters in diameter, we should find in each case that the porosity, under similar ramming conditions, was the same; but we should find that there was a great difference in their permeability or venting properties. The sand of so fine a grain as 0.05 millimeters would offer a much greater resistance to the passage of gases than the coarse grained 1-millimeter sand.

Various methods have been suggested from time to time for measuring the permeability of sands by determining the time required to pass a certain volume of air through a definite body of sand. These methods are not complete and are not comparable one with another. Sand permeability may be compared with electrical conductivity, and in this connection it is worthy of note that there is a definite standard of electrical conductivity, or rather of its converse resistance, which is known as the ohm.

All resistances are measured in terms of this unit and the resistance of one centimeter cube of any substance is known as the specific resistance of that substance. Therefore, as the resistance varies directly as the length and inversely as the area of cross section, we can calculate the resistance of any conductor; when knowing the specific resistance. It would appear from analogy that once we have determined the permeability, (or rather the impermeability, for that is what we actually measure), of any body of a certain sand rammed to a certain density, we could calculate the impermeability of any other body of the same sand rammed to the same density.

Unfortunately it is not practical to ram up a body of sand more than about an inch thick, so that its permeability is the same throughout its depth, no matter how the ramming is done. It is common knowledge that a deep mold rammed up on a jolt machine is harder at the bottom than the top, while in squeezing a deep mold, special precautions have to be taken to prevent the mold being too soft at the bottom.

Hand ramming is out of the question, as it is too irregular. As a result of this reasoning we arrive at the conclusion that in testing molding sands for permeability, certain dimensions for the test piece must be agreed upon and closely adhered to, if we are to be able to compare our results one with another. Further, we must ram our test pieces under identical conditions and test them under similar pressures of air. Time and space do not permit of a description of the method proposed by the American Foundrymen's association joint committee on molding sand research for testing the permeability of sands.

Varying Moisture Content

However, reference should be made to this description, when it will be seen that all the variables are so standardized as to render accurate and comparative results possible. The permeability is there defined as the volume of air forced through unit volume of sand in unit time by unit pressure. Recommendations are made that each sand be tested with varying moisture contents, with a view to determining at what percentage of moisture maximum permeability is obtained.

The writer advises that tests be made to determine the effect of different degrees of ramming on the permeability of the sand, not out of curiosity or any desire to complicate the test but for the following very practical reason.

It is common knowledge among foundrymen that some sands are so susceptible to ramming conditions that there is little or no margin between soft ramming with consequent swelling, washing or buckling of the mold on the one hand, and hard ramming resulting in blowholes and scabs on the other hand. Other sands can be rammed hard and yet behave well in practice. The former class of sands can be detected by a rapid decrease in permeability with increased ramming, on test. Such sands are costly by virtue of the difficulty in working with them, for either production is hampered or an excessive percentage of wasters produced.

Both the variations in permeability occurring with varying moisture or ramming are closely connected with the internal structure or grading of the sands, and no survey of our knowledge of the variation of permeability with grain size and moisture content would be complete without reference to the work of H. A. Schwartz, who has dealt with it fully both from the practical and mathematical standpoints.[6]

As the result of his researches he formulates the following conclusions, upon which the writer comments.

Sands of absolutely uniform grain size are the most pervious.

(But the finer the grain, the lower the permeability, the porosity being unchanged.)

The relation between grain size and perviousness is too complicated to permit drawing any conclusions.

The perviousness cannot be readily and cheaply determined by means of direct experiment.

The sieve test of sand is of academic interest only and means practically nothing in a study of the commercial properties of molding sands.

(The writer has already dealt at length with the grading of sands and has criticized the sieve test rather severely; but if a sand is shown by actual test to be impermeable, the case is only diagnosed as being impermeability; useful to know, but not very helpful. The disease may or may not be economically curable, but a careful grading of the sand, preferably with the elutriator, and a little thought will often show us where the trouble lies, and will assist us in deciding whether we can improve the permeability by blending with another sand or whether it will be cheaper to discard the defective sand.)

The perviousness of molding sand depends on its moisture content and in the beginning increases with increase in moisture as in any previous soil.

[6]H. A. Schwartz. *Proceedings* American Foundrymen's association, 1922.

TABLE II

Sieve Test of Belgian Yellow Sand

Grade	Per Cent	Unit Value of Bond mgm. per 100 grams of Sand	Total Value of Bond x Per Cent	Specific Surface sq. cm. per c.c.	Surface of Each Grade per 100 grams.	Mean Bond in Relation to Unit Surface Area. Mgm. of Dye per sq. cm. of Surface
Number						
Sieve 60...	1.4	4,250	5,950	125.6	8,370	0.5080
Sieve 90...	38.7	3,800	147,060	190.0	12,666	0.3000
Sieve 120...	48.0	3,420	164,160	261.5	17,434	0.1962
Sieve 200...	5.6	5,080	28,450	393.0	26,200	0.1939
Through 200	6.1	17,000	103,700	.....	.....	.....
Total.....	99.8	.....	449,320	.....	.....	.....

Calculated Value of Bond=4,493. Actual Value, 4,500.

TABLE III

Sieve Test of Mansfield Sand

Grade	Per Cent	Unit Value of Bond mgm. of Dye per 100 grams of Sand	Total Value of Bond x Per Cent	Specific Surface sq. cm. per c.c.	Surface of Each Grade per 100 grams.	Mean Bond in Relation to Unit Surface Area. Mgm. of Dye per sq. cm. of Surface
No.						
Sieve 60...	0.75	950	712	125.6	8,370	0.1131
Sieve 90...	9.15	1,005	9,190	190.0	12,666	0.0794
Sieve 120...	27.20	1,090	29,700	261.5	17,434	0.0622
Sieve 200...	46.30	1,270	58,450	393.0	26,200	0.0483
Through 200	16.60	1,873	31,050	.....	.....	.....
Total.....	100.00	.....	129,102	.....	.....	.....

Calculated Value of Bond 1,291 Actual, 1,225

One of the most important results in this research lies in the fact that the finer the sand the greater the increase in permeability with increased moisture content; the maximum effect being obtained in all cases with about 7½ per cent of moisture.

What influence has the daily routine of milling and casting upon the permeability of the sand?

Increase and Decrease in Permeability

R. J. Doty, has shown[7] in a carefully conducted research on a synthetic steel molding sand extending over 22 days, that the average grain size increased from 0.0128 inches to 0.0148 inches owing to incrustations of clay forming around the grains of sand. Unfortunately no permeability figures are given, and as we cannot predict the permeability from the sieve tests or from the average grain size, we can only say that the permeability is probably improved. The writer also has shown this increase in grain size to occur in naturally bonded green-sands taken from the mold face. He further has shown that milling decreases the percentage of sand grade and increases the percentage of silt and clay grades, thereby causing a positive and definite decrease in the permeability.

While it is possible under certain circumstances for these phenomena of increase and decrease in permeability to balance each other, results go to show that with naturally bonded sands and average English milling equipment, the sand tends to become finer and to lose its uniformity of grading and hence to become less permeable. It is worthy of note that in England, and probably universally, large sums of money are wasted annually owing to faulty design of sand mills; not only because the sand is partially degraded, but also in wasted horsepower.

We have previously considered the nature or valuation of the bond, and have arrived at the conclusion that although we may obtain much information regarding either the amount of bond or its quality, it is only by testing the actual strength of the sand that we can take into account many other essential factors, such as the total surface to be coated and the even or uneven distribution of the bond.

It would appear to be a simple matter to ram up a test bar in sand and to determine the load required to break it. Where the difficulty lies is in ramming two more test bars from the same sand so that all three will give concordant figures. This matter has been carefully investigated by R. J. Doty[8] who was dissatisfied with the accuracy of the methods he employed and tried in turn the overhanging bar test, the horizontal tensile, vertical tensile and the overhanging bar test again, with certain refinements in filling the corebox and ramming up the test piece. Concordant results were now obtained from different bars made with the same sand.

Another difficulty was then encountered; sands that were stronger than the average did not show a corresponding increase of strength on test. This was found to be due to the fact that the stronger sands bearing more clay than the average had a higher porosity when filled into the corebox. A standard weight of sand was taken, calculated to a dry sand basis, rammed to a standard volume.

Working independently, the writer arrived at the same conclusions as Mr. Doty as regards working on a definite weight rather than a definite volume. However, the question of variation with moisture content did not obtain in this case, as all sands were tested at a predetermined moisture content.

The connection between this matter and the increase of permeability with added water, noted by H. A. Schwartz is most interesting.

Concordant results were obtained by Doty after all the precautions noted here were taken, and this method has formed the basis of the method proposed by the American Foundrymen's association's joint committee on molding sand research.[9]

This method which is too detailed to describe here should be referred to, and if, at first sight it should appear to be somewhat complex, it must be borne in mind that none of the refinements have been added save to overcome some difficulty which has occurred during the preliminary research.

The brassfounder may dispense with the chemical analysis of molding sands. The successful steelfounder will never be able to do so, and the writer recommends that this test be used intelligently only when it is needed. In analyzing molding sands, the following precautions should be observed. The filtrate from the bulk of the silica, should be taken again to dryness, and the remaining silica extracted. Titanium always should be estimated, as it frequently occurs in amounts too large to be disregarded. No matter how high an opinion an operator may have regarding the accuracy of his work, he should under no circumstances estimate the alkalies by difference on the assumption that his other determinations are correct.

Determine Total Grain Surface

The logical and practical superiority of elutriation, followed by separation of the sand grade on roundholed sieves, over the sieve test as usually performed, has been fully discussed.

This test is useful, in that the total grain surface may be determined from its results, and also defects in the mechanical composition affecting the permeability may be traced, further we can obtain the ratio of static to mobile bond.

The following precautions should be observed in using the Crook type of elutriator.

The water should be at a uniform temperature of 15 degrees Cent., and should be reasonably free from dissolved air and organic matter and similar impurities.

[7] R. J. Doty. *Proceedings* American Foundrymen's association, 1922.

[8] *Proceedings* of the American Foundrymen's association, 1923.

[9] C. W. H. Holmes, *Journal* British Iron and Steel Institute, 1923.

PROPERTIES OF SPECIAL WELDING RODS

(Concluded from Data Sheet No. 526)

Physical Properties

Rods shall be straight and of homogeneous structure.

Surface Finish

The surface shall be smooth and clean.

Recommended Sizes

1/16, 1/4, 5/16, 3/8 inch diameters.

Tests

In the hands of an experienced welder welding rods shall demonstrate good weldability and shall flow smoothly and evenly without any unusual characteristics.

Packing

Rods shall be delivered in coils or in straight 36 inch length except as otherwise specified and shall be packed and wrapped as follows:

(*a*) Bundles of 50 lb. net weight, securely wired and wrapped in heavy weatherproof paper.

(*b*) Bundles of 50 lb. net weight, securely wrapped in heavy burlap.

(*c*) Boxes or kegs of 100, 200 or 300 lb. net weight, and wrapped as per paragraph (*a*).

(*d*) Boxes or kegs of 100, 200 or 300 lb. net weight, wrapped as per paragraph (*b*).

(*e*) Coils of approximately 50 or 100 lb. net weight, and wrapped as per paragraph (*a*) or (*b*).

Marking

All bundles, coils, boxes or kegs shall be provided with a metal, linen or strong fibre tag securely wired to or in the case of boxes or kegs, nailed on the outside, bearing the following information.

Make.....
Nominal Weight.....

MISCELLANEOUS USEFUL INFORMATION

Doubling the diameter of a pipe increases its capacity four times.

A gallon of water U. S. standard, weighs 8⅓ pounds, and contains 231 cubic inches.

A cubic foot of water contains 7½ gallons, 1,728 cubic inches, and weighs 62½ pounds.

To find the pressure in pounds per square inch of a column of water, multiply the height of the column in feet by 0.434.

Steam rising from water at its boiling point, 212 degrees, has a pressure equal to the atmosphere, 14.7 pounds to the square inch. The evaporation of 30 pounds of water per hour from a feed water temperature of 100 degrees Fahr., into steam at 70 pounds gauge pressure is a standard horsepower.

To find capacity in gallons of a tank of any size: Square the diameter, multiply by the length and by 0.0034.

To ascertain heating surface in tubular boilers multiply two-thirds the circumference of boiler by length of boiler in inches and add to it the area of all the tubes.

One-sixth of the tensile strength of a plate multiplied by the thickness of the plate and divided by one-half the diameter of boiler gives safe working pressure for tubular boilers.

For marine boilers add 20 per cent. for drilled holes.

To find the capacity of an air compressor in cubic feet of free air per minute: Multiply the area of low pressure cylinder, on compound compressor, or area of simple compressor cylinder in square inches, by the stroke in inches, and divided by 1728; and multiply this result:

(a) In single acting, simple or compound, by the revolutions per minute.

(b) Double acting, simple or compound, by 2 × revolutions per minute.

(c) Duplex double acting, by 4 × revolutions per minute.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

THE FOUNDRY DATA SHEET, JUNE 1, 1924
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

H. M. RIDDLE, President JONATHAN BARTLEY, Vice President E. H. THOMPSON, Secretary H. M. RIDDLE, JR., Treasurer

WATER POWER MILLS

THE ASBURY GRAPHITE MILLS

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NEW YORK OFFICE 50 CHURCH STREET
MAIN OFFICE AND WORKS ASBURY, N. J.

June 1st-1923

J. D. Pease, Director Advertising Sales,
The Foundry,
Cleveland, Ohio.

Dear Mr. Pease:-

I am, personally, very glad to reply to your letter of the 23rd inst. and to state that the "FOUNDRY" has become an institution with us.

We have advertised in your valuable paper at intervals for many, many years, and it is a great pleasure to give you a word of commendation.

I have recently returned from a trip around the world and one of the miners of Ceylon Plumbago in Colombo mentioned to me the fact that they were advertising in the "FOUNDRY." Now what more can I say?

With personal regards,

Yours very truly,

THE ASBURY GRAPHITE MILLS

By H M Riddle

EHT

•ASBURY•

GRAPHITE PRODUCTS

TABLE IV

Bond Test on Mansfield Sand

A Size of Grain in mm.	B Per Cent	C Unit Value of Bond mgm. of Dye per 100 gm. of Sand	x	D Total Value of Bond Per Cent (B x C)	E Specific Surface sq. cm. per cc.	F Surface per 100 gm. of Each Separate Grade cm.²	G Total Surface of Each Separate Grade $\left\{\frac{B \times F}{100}\right\}$ cm.²	H Value of Static Bond. mgm. of Dye per sq. cm. of Surface $\left\{=\frac{C}{F}\right\}$	Mean Value of Mobile Bond mgm. of Dye per sq. cm.	Mean Value of Total Bond mgm. of Dye per sq. cm.e
<1.0 >0.50	0.10	.....		.....	62.8	.....	.....	.....	.....	.....
<0.50>0.25	3.40	165		561	125.6	8370	284	0.0197	0.0377	0.0574
<0.25>0.10	80.20	330		26466	314.2	20950	16800	0.0157	0.0377	0.0534
<0.10>0.05	8.40	650		5460	628.4	41900	3520	0.0155	0.0377	0.0532
<0.05>0.01	0.90	3630		3267	3142.0	209500	1885	0.0173	0.0377	0.0550
<0.01	7.00	12110		84770	.....	.....				
Total.....	100.00	.....		120524	.....	.....	22489	.....	.....	.....
Calculated Bond Value, 1205.		Estimated, 1225.			Static Bond, 29.6 per cent.					

The apparatus must be absolutely vertical, especially the sand grade tube.

The height of water in the manometer tube is no guide to the velocity of the water current which must be checked at each estimation.

The screw clip between the sand grade tube and the silt grade vessel must be half closed for the last 10 minutes of the test.

The dye absorption test has been proved to be of value in research, and as the cohesiveness can be determined only on considerable quantities of sand, the dye test would appear to have a use in dealing with such small quantities as cannot be tested by other methods. In connection with the bond distribution factor

$$\frac{\text{transverse strength (gm)} \times 100}{\text{Mgm. dye adsorbed per 100 gm sand}}$$

this test is of use in enabling us to determine the shortest milling period required to produce maximum effect.

The American Foundrymens association research committees proposed method has already been commended as being based on sound principles. But because the mathematician already has put his finger on molding sand research as a promising field for himself, and also because foundrymen may wish to do some simple arithmetic themselves in connection with sand testing, it appears to the writer that a simplification would be useful.

Some of the units in the test are in inches and pounds and some in metric measure; and it would seem preferable to change the volume of sand under test from 5cm., 08 (2 inches) in height and 20cm$_2$ 268 in area (3,1416 square inches) to 5cm. high and 20 cm$_2$ area.

Also the compression is affected by three blows of a rammer weighing 14 pounds (6,350.36 grams) falling through 2 inches (5cm. 18).

This gives a total of 7 foot pounds of work=0 kgm. 9695 on an actual area or 20 cm^2 268 or a proposed area of 20 cm^2=0 kgm. 0485 per cm^2 on the proposed area.

Why not compress the sand by 0 kgm. 05 per cm^2 giving a total of 1 kgm. of work done on the total area of 20 cm$_2$, and effecting this by a weight of 1 kg. falling 10 cm. ten times.

It seems logical to standardize and simplyfy each factor that may subsequently be required in calculation; and again the effects of variations in ramming can be studied more easily with 10 blows than it can with three.

Here again the method proposed by the American Foundrymen's association's joint research committee is far in advance of anything which has previously been suggested. Nevertheless a similar mixture of English and metric units occurs; and this can be remedied by departing only slightly from the present dimensions of the test piece. As proposed the test piece is 16 x 2 x 1 inch and is compressed by a weight of 20 pounds falling 16 inches ten times; or 266 foot pounds.

Standardization of Test Pieces

Would it not be preferable to make the test piece 40 cm. x 5 cm. x 2 cm. .5, (a trifling difference from the present size) giving a total surface under compression of 200 cm^2 and to so adjust the falling weight (in kilograms) and height (in centimeters) that the work done per cm^2 of surface became a simple number. The original ratio works out approximately to 0 kgm. 182 per cm^2 surface.

On the 40 cm. x 5 cm. x 2 cm. .5 test piece a weight of 8 kg. dropped 50 cm. ten times would work out at 0 kgm. 20 per cm.^{2} of surface. This unfortunately is four times as great as the work done per

TABLE V

Bond Test on Belgian Yellow Sand

A Size of Grain in mm.	B Per Cent	C Unit Value of Bond mgm. of Dye per 100 gm. of Sand	x	D Total Value of Bond Per Cent (B x C)	E Specific Surface sq. cm. per cc.	F Surface per 100 gm. of Each Separate Grade	G Total Surface of Each Separate Grade $\left\{\frac{B \times F}{100}\right\}$	H Value of Static Bond mgm. of Dye per sq. cm of Surface $\left\{\frac{C}{F}\right\}$	Mean Value of Mobile Bond mgm. of Dye per sq. cm.	Mean Value of Total Bond mgm. of Dye per sq. cm.
<1.0 >0.50	0.20	.....		.....	62.8	.....	.....	.....	.....	.....
<0.50>0.25	4.80	1082		5193	125.6	8370	402	0.129	0.156	0.285
<0.25>0.10	78.40	920		72128	314.2	20950	16425	0.044	0.156	0.200
<0.10>0.05	5.80	6180		35844	628.4	41890	2430	0.147	0.156	0.303
<0.05>0.01	1.10	13900		15290	3142.0	209500	2304	0.066	0.156	0.222
<0.01	9.70	34700		336590	.....	.....				
Total.....	100.00	.....		465045	.....	.....	21561	.....	.....	.....
Calculated Bond Value, 4650.		Estimated, 4500.			Static Bond, 27.6 per cent.					

unit area in compressing the permeability test piece and it seems probable that we may wish to correlate permeability and cohesiveness at some future date.

Not having as yet worked either of these tests exactly as specified, the writer cannot vouch as to the feasibility of the proposal; but there would appear to be a distinct advantage in carrying out both tests on sand rammed under the same conditions—say 0 kgm. 10 per cm.^{2}.

In concluding this paper the writer wishes to appeal most strongly for international standardization in the testing of molding sands, both in the methods and in the units employed. If, at this International conference, we all spoke a common tongue, its scope would be enormously increased, to the benefit of all concerned, and if we meet on common ground with our molding sand problems we shall be much nearer to their solution.

For comparison of results obtained with the sieve test and with the elutriator, with special reference to the distribution of the bond, two sands have been selected, one of which is famous wherever steel castings are made, the other an iron and brass founders' sand, is equally valued in its own sphere.

The sands have been graded by either the sieve test or by the elutriator and the results of bond determinations made on the different grades are shown in Tables II, III, IV and V. However, it is not proposed to discuss them, as the work done in this direction is not sufficient to permit of any definite conclusions. They are included to demonstrate the differences between sieving and elutriation. They show, probably for the first time, the ratio between the static and mobile bond, and will, the writer believes, provide food for thought for every progressive foundryman.

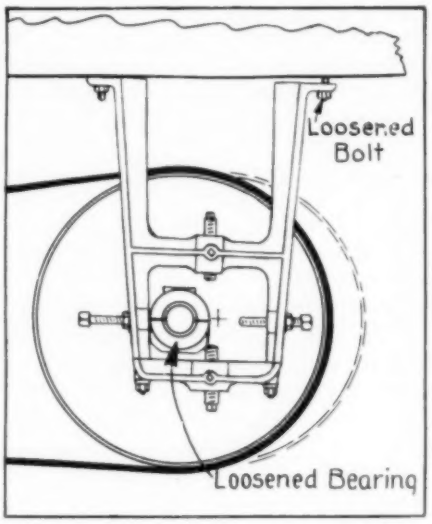
Consider Standardization

A conference on the standardization of cast iron pipe is to be held in the Engineering Societies building, New York, June 5. This conference has been called by the American Engineering Standards committee in accordance with the recommendation of a special committee made up of representatives of the organizations chiefly concerned with the subject. That committee was organized to consider the requests of the American Gas association and the American Society for Testing Materials for the approval, by the American Engineering Standards committee of their respective specifications for cast iron pipe.

Method for Putting Belt on Pulley

By W. F. Schaphorst

Millwrights agree that it is bad practice to run a large belt on a pulley by forcing one of the edges to catch and then running the belt on either by hand or power. Permanent injury may be caused by this practice since the belt may be stretched more on one side than on the other. To avoid this condition instructions often are issued to make leather belts endless by belt clamps, etc., while they are on the pulleys. However, this method



ADJUSTING SCREWS AND HANGER BOLT ARE LOOSENED TO ASSIST IN PUTTING ON THE BELT

not always is practical and sometimes it is impossible practicularly if the belt already has been made endless by the manufacturer, as often is the case.

Where conditions allow, a good method for putting large belts on pulleys is to loosen the adjusting screws on the hangers, as is shown in the accompanying illustration. This permits the shaft to move over a considerable distance, temporarily shortening the distance between shaft centers. Sometimes the shaft may be moved inward 2 inches or more, thus making it possible to put the belt on easily. Shortening the center distance 2 inches virtually adds 4 inches to the length of the belt. To assist further one of the hanger bolts may be loosened to allow the hanger to swing inward still more. Where patented overhead beams are employed it sometimes is possible to slide the entire hanger forward without touching the adjusting screws. All of these methods are possible yet, they are seldom used.

In the sketch, which is drawn slightly exaggerated to emphasize the points described, the cross lines indicate the position of the center of the shaft after the beam bolt is retightened and the adjusting screws put in the original position. The dotted curve lines indicate the position of the pulley rim after the screws are retightened.

This method not always is practical where belts are running in both directions, as on a common line shaft, but where it can be employed, the method is worth while. It is quick and simple, and a considerable saving can be realized where large and expensive belts are being used.

Attaching Steel Plates To Vise Castings

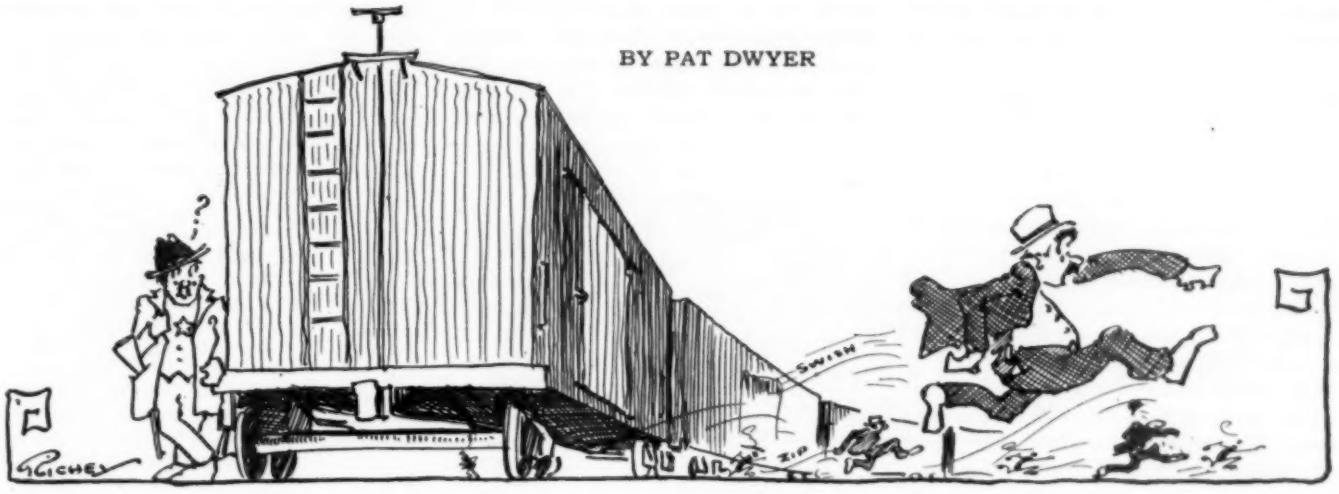
Question: We are having some trouble with a vise jaw casting in which a steel plate is placed in the mold and the iron is poured against it. When the iron is poured at a low temperature the plate does not unite with the iron. When extremely hot iron is employed the iron sticks to a certain extent but the face adjoining the steel plate is filled with blowholes varying in size between that of a pin head and a pea. We have tried every remedial measure with which we are familiar, but without success and will appreciate any information you can give us on the subject.

Answer: Considerable trouble is experienced at times in every foundry where steel faced vice jaws are cast. The process is comparatively simple but unless every detail is watched carefully the castings will go to the scrap pile. The mold is gated in a manner that will permit the stream of iron to flow across the plate all the time the mold is filling. In some instances it is necessary to flow a certain amount of iron through a riser provided for the purpose. The correct amount to flow through only can be determined by experiment. The blowholes are traceable to one or both of two direct causes, dampness or rust on the steel plate. The dampness can be prevented by heating the plates slightly before they are placed in the molds. The molds must be poured shortly after the plates are placed in position to avoid moisture.

Many agents have been employed to prevent oxidation on the face of the plate. The face of the plate is ground perfectly clean before it is placed in the mold, but if it is allowed to stand for a short time an oxidized film gathers on the surface and with a view of preventing this, the face is covered with a protective coating. Coating materials include red lead, coal oil, shellac, chalk, tar, sodium silicate (water glass) and tin. Of these, tin probably is the most satisfactory.

Bill Airs Views on Sashweight Castings-VI

BY PAT DWYER



SINCE I retired from the road more or less willingly several years ago I have lost contact with nearly all the wandering birds of passage who floated on easy going pinions around the foundry circuit. Occasionally I hear directly or indirectly of one who has settled down, of a second who has died and of another who has quit the sand heap for an easier and perhaps more lucrative form of occupation. Apparently only a small number of genuine side door Pullman patrons remain in the land and with a continuation of present conditions I am inclined to the opinion that the traveling molder soon will be as extinct as the Dodo or the Great Auk.

Several factors are responsible for this melancholy state of affairs and according to the opinion of many earnest students the most important is the 18th amendment of the Constitution of the United States. In support of this contention, these learned gentlemen point to the fact that in European countries where no inhibitory measures of this kind are in force the army of involuntary tourists is as great if not greater than at any time in history. Figures are wonderful things.

In former years many men traveled extensively from a variety of motives ranging from an acute attack of ordinary wanderlust to a deliberate and well conceived purpose of studying conditions, methods and processes in many foundries. However, it must be admitted that the greater number traveled from an impulse generated from a too liberal indulgence in what was known colloquially as bug juice. With a sufficient quantity of this wonderful invigorator under his belt, a young man naturally scorned the dull, prosaic routine of his daily existence. He experienced an uncontrollable impulse to jump around a little and while still in an exalted condition he usually jumped his job and jumped out of town.

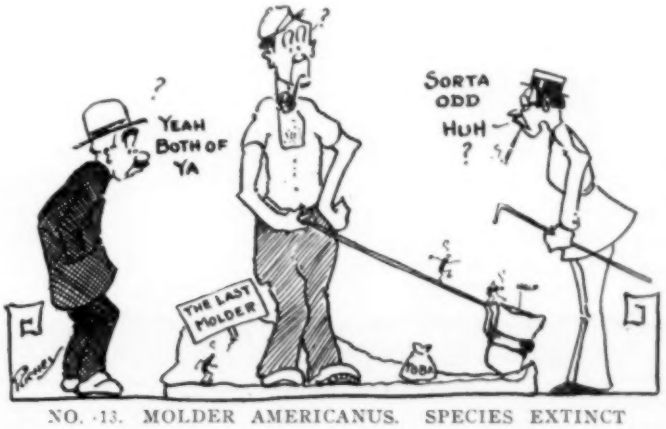
The idea of paying railroad fare to any public utility octupus naturally was repugnant to his finer sensibilities. He cheerfully hopped a rattler and invested the money he saved in this manner in a further supply of the old reliable at Joe's Place. With the supply of artificial stimulant cut off through a price that is prohibitive to a hard working and honest artizan, brake rods, bumpers, blind baggages and interiors of box cars and gondolas with all their attendant hazards and discomforts do not appeal to him.

In this connection it is interesting to speculate on what is to become of the vast army of vigilant gentlemen whose activities were devoted to a suppression of promiscuous migration. They infested freight yards to a disconcerting extent and at times interfered seriously with a traveler in his choice of a train. Among the members of the traveling fraternity they were referred to feelingly as Bulls, Dicks and Square Toes. Although at times the two parties associated intimately, their relations never were characterized by that cordiality which promoters of better relations assure us should obtain between two classes of men where the activities of one depends on the existence of the other.

However, that is a digression. Let us return to the main theme. The modern young molder may have heard that far-away cows have long horns, but he is more inclined to pin his faith on the antithesis which sets forth that it is better to live with the devil you know than it is to live with the devil you don't know. And that's that.

Moralizing on a subject may serve to pass an odd half hour, but it is of no more practical benefit in coping with an actual situation than a congressional investigation is of service in clearing up a national mystery. The hobo molder is going, going, and soon will be gone. Theorizing on the cause will not prevent his ultimate disappearance. I shall not be surprised unduly some fine day to walk into a place like the Carnegie museum in Pittsburgh to find a stuffed specimen labled "The Last One." From what I have seen of artists and their work I miss my guess if the taxidermist does not show the molder holding a hand ladle in an impossible position and clothed in a set of garments immeasurably superior to anything ever worn by the original during his actual career in the foundry.

Have you ever noticed the fine, substantial shoes



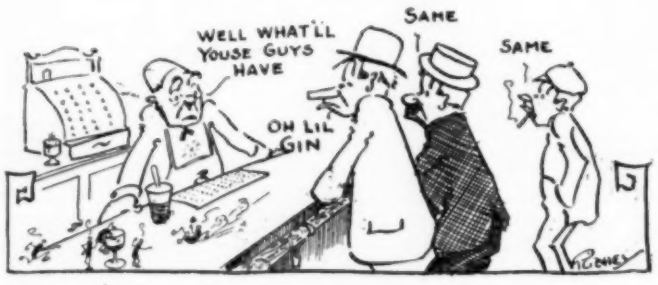
NO. 13. MOLDER AMERICANUS. SPECIES EXTINCT

invariably shown on the feet of bronze and other figures? I have checked up on this feature every time I have had an opportunity to examine a wax, a plaster or a bronze figure and I never have seen an old or a worn pair of shoes. On the other hand I have seen more old shoes in the foundry than there are rocks in the State of Vermont, or would-be actors in Hollywood, California. According to rumors that drift back occasionally from this favored land some of the actors' shoes are not altogether above reproach.

The foregoing train of thought was started in my mind today by a letter I received from one of the old guard whom I have not seen for many years. At one time he and Bill and I were doubled-up on a job in Baldwin's old shop near Broad and Spring Garden streets in Philadelphia. We closed the mold about 2 p. m. every day and then Bill and this lad, both ardent ball fans, grabbed their coats and flew away to attend the ball game while I remained to place the weights on the cope and pour the iron later in the afternoon. We were paid on a piece rate basis and so long as we turned out one casting per day the foreman did not care whether one man or three men remained to pour it.

Finally for various reasons we decided that Philadelphia had gone stale and if life were to remain worth living it behooved us to seek other territory. We drew our last pay and repaired to a famous first aid station on Arch street to decide whether we should go north, south, east or west. I do not remember the name of the place but some old timer may recognize it when I say that a beautiful glass hand rail, a 4-inch tube filled with wax leaves and flowers in natural colors, ornamented the front of the bar.

In this charming and secluded retreat we leisurely discussed the relative merits of many prominent foundry centers, but failed to agree on any one. As a result we separated. Bill disappeared in the general direction of Pittsburgh. I headed for a town in Connecticut of which I had heard favorable reports. Long Joe, the third member of the party started on the first lap of a long jaunt which he hoped eventually, wind and weather and bulls permitting, would land him in Birmingham, Alabama. I never met him afterward and the first intimation I had that he still was in the land of the living arrived in the shape of a letter yesterday, post marked Milwaukee, Wis.



INTERIOR OF OLD TIME LIFE SAVING STATION

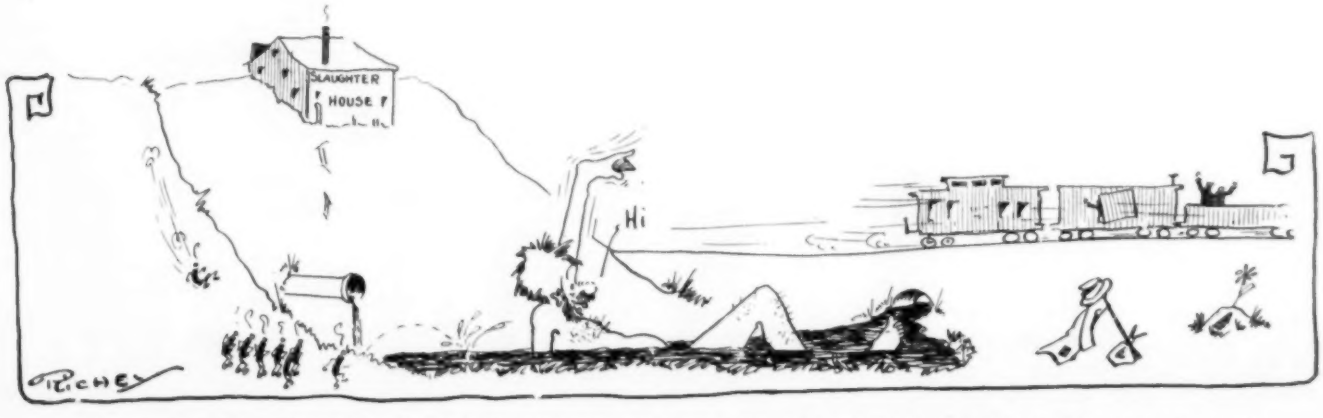
Was Exceedingly Loquacious

Joe was a first class molder, but partly through lack of early opportunity and partly through a natural and deep rooted aversion to the practice he never developed any marked proficiency as a letter writer. However, what he lacked in style and technique he made up in loquacity. His letter might not qualify for a place in the *Ready Letter Writer*, but it served to convey his thoughts in a perfectly understandable manner and, in the last analysis, that is the most satisfactory test to apply to any letter. I reproduce it here in its entirety with the exception of a few expresisons which Joe used in all simplicity, but which Mr. Webster and his faithful old ally Mrs. Grundy refuse to recognize. Joe—honest lad that he is—is an ardent supporter of simplified spelling.

Dear Frend: I now take my pen in hand to drop you a line hopping it finds you wel as it leaves me at present. I was reding one of your peaces in THE FOUNDRY today and I woodent of knew it was you if you had not menjent Bill and something he said reminded me of the time me and you and him worked in Philly. I been back and forth to the coast 4 or 5 times since them days in Bill Penn's town and its funny I never run acrost neither of you birds nowheres. I bloo into this burg about a week ago but believe me it aint the place it used to be. I herd the foundry convention is coming here this fall. Is that right. Dont them birds know all the breweries is shut down. Stillanall I dont suppose it makes much difference where they go. All the towns are alike except Montrehall. Im figgering on going up that way this summer and stick around for a few months. You know its kinda queer the way I run acrost your adress. Im making a job in the floor, see, with a deep lift and I asks the gaffer for some paper to make the parting. He sends a kid into the office for a bundle and the young dumbel brings back a newspaper and an old foundry. I tacked the newspaper over the parting and was going to tear a few leaves out of the foundry to finish the job when I seen your name and started to read the story. Say, the pitchures sure is comical but you and Bill must have changed a lot since I seen you. I never would of knew you. Well, so long I aint got nothing particular to write about. When you see Bill give him my best and tell him I may stop of for a day to see you and him on my way east pretty soon. Joe.

I went over to Bill's house last night to show him the letter. He was greatly pleased to hear from the rambler but he was not particularly interested in Joe's proposed trip to Montreal.

"If he was *coming* from there, now," he said, "It would be a different story. I should like to take a trip up there myself. I suppose the old town has changed quite a bit since I worked there many years ago. I spent a few months in McDougall's, then tried a spell in the



NO, MY DEAR, YOU ARE MISTAKEN. HE IS NOT ONE OF THE FAMOUS BATHING BEAUTIES OF 1924

steel shop and the last job I had there was in a little brass shop owned by a molder who had started in business for himself. He was a clever lad who knew all the tricks of the trade and made all his castings from scrap metal. One day the purchasing agent of a big company came in to order some castings. He wanted a special price because he had to conform to rather severe specifications and the foundryman told him he would have to have all new metal. 'Oh! That's alright' said the lad airily. 'The stuff we have in stock is practically new. We only purchased it about three weeks ago!' However, it takes all kinds of people to make a world and I suppose that is the reason there are so many ways of making sashweight castings.

"Among the many methods available for making sashweight castings, that presented by the permanent mold appeals most directly both to practical foundrymen and others who may not be familiar with the actual details of producing castings. The first class realizes many of the problems involved but at the same time considers that if any castings may be produced successfully by this method, sashweight castings should head the list. The shape offers no resistance to contraction and the fact that they may or may not be chilled on the surface has no bearing whatever on their ultimate use.

"The second class of men who may contemplate employing this method are not hampered by any experience that might tend to warn them of physical, chemical or mechanical difficulties that accompany any attempt to make castings in any but the long established and conventional methods. On the face of the proposition nothing could be more simple. All that is required is an iron mold. Apparently it may be set up anywhere that molten iron is available and may be filled and emptied indefinitely. The method undoubtedly represents the simplest factors to which the casting industry may be reduced. However, simple as it is, certain fundamental features must be kept in mind, both in designing the equipment and later, in using it.

"The phenomenon of expansion and contraction under temperature changes is the most important factor to be considered. The molds must be designed and operated in a manner that will insure a practically uniform temperature at all times. Two types of permanent molds have been developed to meet this condition. The first is heavy and massive and is based on the fact that iron absorbs heat rapidly and radiates it just as rapidly. The amount of heat absorbed for example by a 1000-pound block of iron from a few small sashweight castings easily is dissipated before the mold is filled the second time and the performance may be continued practically indefinitely. This type of mold was designed some years ago by Edgar Allen Custer and operated successfully for some time under his direction. The mold for the sashweights was in two parts, one stationary and one movable. The movable section was operated by a lever and toggle arrangement and was provided with ejector pins that threw the castings out of the mold each time it was opened. The main objection to this mold is the comparatively high initial cost. No figures are available on the productive life of the mold. It was in good condition when finally laid aside after turning out many thousands of castings.

"The second type of permanent mold employed for making sashweight castings, one that has been adopted by several foundries with apparently gratifying results, is a water cooled mold set up in batteries for convenience in pouring the iron and shaking out the castings. Practically every foundry is located in a community where water is distributed through mains from a central source of supply and a minimum of pipe fitting is required to connect the batteries of molds to the water main. Where water under pressure is not available, a tank and a small pump will supply all that is required. In fact, where the water is metered it may be advisable to install a tank and a pump. With this equipment the same water may be employed continuously. The spent water from the molds discharges into a large shallow tank or basin from which it may be pumped into a water tower elevated to a convenient height. From the tower it flows back through the molds by gravity.

"In some installations each mold is designed to form a single casting but usually the mold block contains either a double or a triple mold cavity. Practically the same amount of machine work and fitting is required on a single mold as is involved in the preparation of one with two or more impressions and for that reason the multiple mold is the most economical.

"The mold block is rectangular in cross section. It is split through the center vertically along the natural parting line of the castings. Each half of the mold contains a water chamber which reduces the metal thickness of the mold wall to approximately 1 inch. In making the mold the water chamber core is supported by two 1-inch diameter prints at each end. The core sand afterward is removed through the print openings and then the openings are tapped and plugged. Another opening is tapped and threaded near the bottom for a 1-inch water connection. The spent water flows through a ½-inch pipe screwed into one side of the mold near the top. This small pipe is bent at an angle in the center to direct the flow of water down toward the channel which conducts it back to the collection basin, or the sewer, depending on whether or not it is to be used over again.

"One half mold remains permanently in one position attached to the water pipe connection at the bottom. The other half swings on substantial hinges and the water connection between the main and the mold is maintained through a short section of rubber hose. A steel bar attached to the movable half of the mold is provided with a suitable catch which engages a projection on the stationary half of the mold and serves as a clamp to hold the two halves of the mold together while the mold is being filled with iron. After the castings have set the handle is employed for opening the mold for the removal of the castings.

"Raised figures representing the weight of the casting appear on one side of the mold cavity and are transferred to the castings in recessed form. The castings are poured in reverse position to that they will occupy when in use. The eye for the cord is placed near the lower end of the mold and is formed by suitable projections from each half of the mold which meet in the center. These projections are sharply tapered and present no obstacle to the removal of the casting.

"A convenient pouring basin is formed integral with the upper part of the mold and is connected with the mold cavities through a small opening approximately ¼-inch diameter leading to each mold. The manner in which the iron is poured into the molds is of importance. Any carelessness resulting in splashing the metal may burn the hose connections. However, that is all a matter of training and supervision. Where a battery of molds is in use constantly the pouring gang naturally becomes proficient."

"Leaving the molds for the moment" I said, "and coming back to the subject of tramps and tramping, how would you like to go on the road again?"

"Well," said Bill, "I'll tell you. Since there is not the slightest possibility that I may have a chance to go on the road, I may regard your question as purely hypothetical. I learned that word during the first notorious Thaw trial. It was worked to death at that time, therefore another poke now will not do it any harm. A hypothetical question may be answered in any manner the witness chooses and I'll answer yours by quoting the leisurely remark of a tramp who had listened to a garrulous traveler telling about all the famous springs of the earth in which he had bathed. 'Talking about springs' says our hero. 'The last spring in which I bathed was in the spring of '96.'"

Describes Welding Process

Methods Used for Welding Gray or Malleable Iron Castings at Comparatively Low Temperatures Said to Eliminate Excessive Oxidation of the Metal

BY A. H. JANSSON

THOUGH the art of welding has been highly developed, and its field of application correspondingly enlarged, for repairs and in new work, in manufacturing, in structural steel fabrication and in shipbuilding, a satisfactory method of welding cast iron has been long sought. More than ordinary interest is given to the claims made by the American Ferrolit Corp., 33 West Sixtieth street, New York owner of the American rights for a welding compound by the use of which in conjunction with brass or tobin bronze, cast iron may be welded. This welding compound was discovered by M. A. Abele of Berlin, Germany.

The compound is in the form of a dark gray powder, possessing oxidizing properties, but due to action of heat upon certain of its chemical constituents,

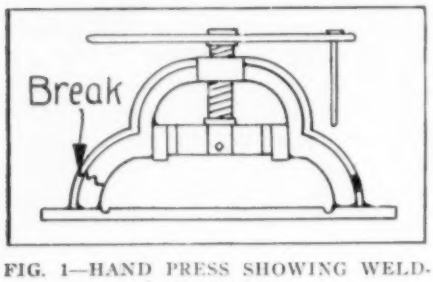


FIG. 1—HAND PRESS SHOWING WELDED PART

also has the property of absorbing oxygen. This causes the material to act as a reducing medium and therefore it may be termed an oxidizing, reducing, welding compound. The principal constituent is an especially prepared iron powder mixed with other chemicals which have the tendency to absorb the carbon from the cast iron, to toughen the metal, and to prevent oxidation. Gray cast iron or malleable iron may be welded at a comparatively low temperature, namely 1700 degrees Fahr., which is the melting point of brass and approximately 700 degrees Fahr. below the melting point of cast iron. A coal forge or commercial gas torch may be used to advantage in this process.

Welding Cast Iron

A sufficient amount of the prepared compound is mixed with water into a fairly thick paste. This paste is applied to the fractured surfaces of the casting after these surfaces have been cleaned thoroughly. The broken parts then are placed together and held firmly in contact, with the aid of a vice, clamp or wire binding. Heat is applied until the correct temperature is reached, indicated by a bright red color. At this point, borax is sprinkled liberally over the fracture. When the borax begins to melt penetrating through the crack, any standard copper brazing material such as brass or tobin bronze is rubbed into the crack at the same time adding more borax. Application of the brazing material, which on melting runs into the crack, is continued until it has penetrated through the entire thickness of the break. This is indicated by the presence of green and blue flames. After cooling the casting in the same manner used for any other welding method, the borax and brass remaining on the surface may be chipped and filed off.

It is not necessary to chamfer the broken surfaces of the casting as the compound used, on account of its chemical properties, allows the molten brass to flow freely through the crack. It is said tests on castings up to 18 inches in thickness have shown complete penetration. As an ordinary precaution, intricate castings are preheated to avoid the possibility of cracking in new places.

Scientific Explanation

Prof. Hanemann, of the Charlottenburg Technical institute, Germany, an authority on metallurgy has made an interesting scientific research into the properties and action of this new welding compound. His report follows:

"It was found in our testing laboratories that the cohesion of the welded joint is extremely strong and the casting tested on a tension strength machine would practically always break again outside of the area of the weld.

"When cross-cuts and filings were made, it was found that the brazing penetrated on both sides of the joint into the cast iron to a depth of approximately 1/5 inch. It is readily understood that when the smallest pores of cast iron are filled with brass an unusual strong and deep cohesion is obtained, but the question arose, whether when large surfaces are welded, the strength of cohesion would not be lost. To test this, a new experiment was made. Two large cast iron plates of 4 x 4-inch cross section were welded together by this process. This experiment gave satisfactory results as it was found that the brazing material penetrated over all of the surfaces. Gross cuts and filings made through the center of these plates have proved that the brass has penetrated in a uniform and satisfactory manners into the cast iron the same way as in the previous tests.

Compound Prevents Oxidation

"A set of experiments has shown that when the welding compound is mixed with water and heated, it will always harden when the evaporation of water begins to take place or at the boiling point of water. At this temperature iron does not oxidize and the oxidizing properties of the compound cease. This

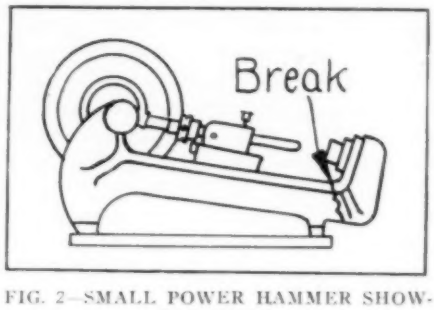


FIG. 2—SMALL POWER HAMMER SHOWING WELD

effect must be explained by the chemical properties of the compound such as the absorption of oxygen by the iron contained in the powder due to which the paste hardens and turns into a hard crust. Therefore, when the welding compound is mixed with water and applied to the surfaces of the broken joint and heated to a temperature up to 212 degrees Fahr., it is transformed into a hard crust. At this temperature the oxides do not yet affect the surfaces of the cast iron treated. The welding compound crust coats the surfaces of cast iron and prevents contact with air thereby preventing oxidation. When being brought to a higher temperature, the air that penetrates between the joint of the fractures is neutralized by the iron powder which starts sparking and absorbs the oxygen. Thus the dangerous contact with air is prevented until the borax is applied on the crack. When the borax melts, it dissolves the crust

which coated the joint. This process is aided by certain chemicals in the welding compound crust which also develop a small amount of borax. Simultaneously with the dissolution of the compound crust by the melting borax, the brass or tobin bronze melts and penetrates between the surfaces of the cast iron. Brass then comes into contact with the clean metallic surfaces of the cast iron and immediately combines with it."

The accompanying illustrations, Figs. 1 and 2, show the nature of practical welding repairs to a hand press and to a small power hammer at the firm of Siemens & Shuckert, Germany. These machines, subsequent to repairs, have been in use for a considerable period of time. In addition to these practical applications a study of the process was carried out in the testing laboratories of this company and parts of the report are given herewith with the figures converted from metric units to English and slight changes in wording to make the meaning clearer.

FIG. 3—A MECHANICALLY CLEAN WELD RUNNING HORIZONTALLY

"A round cast iron bar 0.55 inch in diameter was welded and put on a tension test. The bar broke under a load of 16,550 pounds per square inch. The break occurred outside in the area of the weld. Originally this bar had a tensile strength of 18,600 pounds per square inch. This lowering of tensile strength may be due to the bar being brought up to a red heat which always will force the iron thus treated to lose about 9 per cent of its tensile strength. A microscopic study has shown that in the welded parts, the metal had few pores and was mechanically clean which is seen from the illustration Fig. 3. Upon inspection, no oxidizing mediums, were found except in extremely small quantities. Fig. 5 shows a micrograph enlarged 100 times. The cut was made across the weld. The light places in the illustration show the presence of brass which is evenly distributed over all of the surfaces of the

FIG. 4—TEST BAR SHOWING OCCURRENCE OF FRACTURE OUTSIDE WELDED PART

break and has penetrated into the pores of the cast iron. In this manner, we have obtained an internal cohesion of both joints with the brass."

An additional report from the electrical department of this company states: "The success of welding with the new compound depends on suitable handling of the fractures and on the correct application of the powder itself. The dimension of the welded area depends upon the source of the heat, the method used in heating, and on the good penetration and evenness of the heat, throughout the area subject of the weld."

An interesting weld by this process was made on a broken steam chest and cover for the S. S. LUBECK of the New North German River Steamship Co. in its own repair shops. Due to defective casting this new steam chest gave away in service. The weight is approximately 250 pounds. The time required for making the weld was 18 hours. After the repairs the steamer made a trip from Berlin to Hamburg and return, with a steam pressure of about 235 pounds, per square inch. According to reports the company states that no defects have developed. Other similar welding repairs were made.

Tensile strength tests have been conducted at Columbia university, New York, as follows:

1. A 1-inch square section cast iron bar, butt welded to an equal dimension square steel bar parted in a tensile test at a load of 18,720 pounds, at a point, 1 inch away from the welded joint.

2. A 1-inch square section cast iron bar butt welded to an equal dimension square cast iron bar, parted in a tensile test at a load of 18,940 pounds near the welded joint.

The E. W. Bliss Co., New York, conducted a transverse test with a gray, cast-iron test bar 12 inches long, 1 inch square. The original bar broke at a load of 2800 pounds. On welding the two broken pieces together the repaired bar subjected to a transverse test in the same testing machine broke at a load of 2000 pounds, the fracture occurring about ½ inch from the weld as shown in Fig. 4. Individual ship repair plants in the vicinity of New York have conducted practical welding tests with this new process with satisfactory results.

Why Arms Crack in Small Pulley Castings

Question: Kindly tell me how to prevent the arms from cracking in a cast iron pulley 24-inch diameter, 16-inch face, rim thickness 5/16 inch, arms 1¼ x 2⅝ inches, hub 4½ x 11⅞ inches, center core 2⅛ inches. The iron in the casting yields the following analysis: Silicon 2.51 per cent, manganese 0.41 per cent, phosphorus 0.61 per cent, sulphur 0.08 per cent.

Answer: Your trouble is caused by the glaring disproportion between the metal thickness in the rim and that in the arms and hub. This is accentuated by the fact that probably in accordance with usual practice you pour the casting through the hub. The result is that the rim cools and contracts almost instantly after the iron is poured. The hub and arms cool later and contract a sufficient distance to crack one or more of the arms. Two forms of remedy are available, or possibly a combination of both might prove more efficacious. In the first the thickness of the rim is increased to at least ½ inch. This will help to equalize the cooling speed of the rim and hub. In the second method the silicon and manganese content are increased to 3.00 per cent and 0.60 per cent respectively. This iron is more elastic than the variety you are using at present and will resist the contraction strain without cracking. Whether you adopt the first, the second or both methods you will find it advisable to strip the hub immediately after the iron has set and dig out the center core. If the pulley is made in a flask it may be turned up on edge, the bottom board removed and a ¼-inch rod used to poke a passage through the hub. The current of air passing through the opening in the hub will cool the hub rapidly causing the metal to set rapidly, and minimize the contraction.

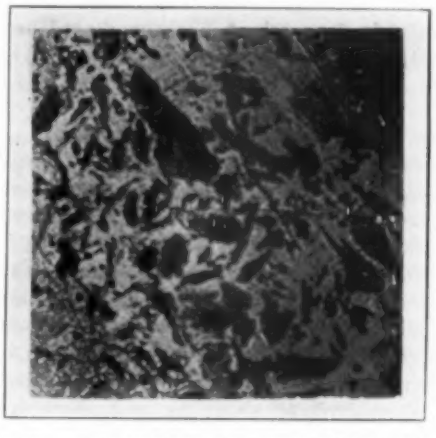


FIG. 5—MICROGRAPH ENLARGED 100 TIMES. LIGHT PARTS DENOTE PRESENCE OF BRASS

How and Why in Brass Founding

By Charles Vickers

Polishing Brass

We understand that brass castings are being given a smooth finish by tumbling them in ordinary tumbling barrels with hardened steel balls, and that it is not necessary to grind them previous to buffing as the tumbling eliminates the slow and expensive method of grinding. Any information you may give us will be appreciated.

Burnishing barrels are being made by a number of concerns and are of different sizes and shapes to suit the kind of work to be polished. A rough cast iron barrel cannot be used until its inner surface has been worn smooth and polished, as the rough iron would abrade the work. A hexagon shaped barrel lined with brass is satisfactory. The operation is a simple one. The barrel is enclosed in a tank because it has to run in a lubricant, such as soapy water made from a good grade of vegetable soap, or containing soap bark or fishoil soap. The barrel should be filled about one-third full of steel balls. Formerly, bicycle bearing balls were used, but now steel balls and burnishing cones are made especially for such barrels. The work is put into the barrel with the steel balls and the barrel is revolved at about 50 revolutions per minute for a period that may extend to an hour or more, or until the objects are polished. Then they are removed and the balls are riddled out. The objects are washed and dried and then are ready to lacquer.

Melt Light Brass Scrap in Crucibles

We have several tons of light brass scrap to melt, consisting of socket shells, canopies, and other light sheet brass. We desire to learn of some economical way of melting it. We use crucibles in oil-fired furnaces and the largest is a No. 200. We have no means of bailing the material. We had a large funnel cast which fitted over the crucible in place of the cover and hung into the crucible, and which worked very well, but the funnel being made of cast iron was so embrittled by the heat that as the light brass was being punched down it broke the funnel in two. In this material is a lot of nickel-plated parts. Will this nickel assist in the leading of the brass?

The best way of melting this scrap would be to do the work in large non-crucible furnaces, but such equipment is not available. The next best thing is to repeat the funnel scheme. This idea was well conceived, but did not work in practice because cast iron is not the right metal to use for the funnel. This latter should be made from some heat resisting alloy, and cast steel would be better than cast iron and will give more satisfactory service.

The nickel in the scrap brass will do no harm, neither will it be of assistance in admixing a large proportion of lead. The nickel simply can be ignored.

Sand Core Mixture for Aluminum Castings

We would like to know just what is the best core mixture for making aluminum castings. We know the mixture varies according to the grade of sand used, but if you can give us some information along that line we shall feel pleased.

It is very doubtful if there is any *best* mixture of sands for making cores for aluminum castings. Some prefer binders of the dextrin order, others use oily binders and still others pin their faith to rosin as a binder. A study of the advertising columns of FOUNDRY will acquaint one with a number of different binders for core sands, and the advertisers of these brands will be delighted to advise as to how these binders should be used, not only for aluminum castings, but for any nonferrous alloy. In these days of *service* by manufacturers, it is difficult to go wrong, because *service* means the business man has studied his product, knows how it should be used, and passes this information on to his customers.

The rosin core has much to recommend it, because rosin softens when heated whether in a core or not, therefore, the core when used softens under the heat carried by the molten aluminum. Being soft it disintegrates, and so offers no resistance to the metal as it contracts. Such a core can be made as follows:

ROSIN CORE

	Pounds
Silica sand, dry	30
New molding sand, dry	10
Powdered rosin	2

Mix thoroughly and wet to the proper dampness with plain water. Then heat the cores until the rosin melts and smokes.

Weight of Aluminum

We desire to know how much a cubic inch of aluminum will weigh? We wish to be able to figure the amount of aluminum required to pour a mold when a wood pattern is used. Also, if an iron pattern weighs one pound, what would a casting made thereof weigh in aluminum? And what is the best alloy to use for making match plates for bench molders?

We would not care to go on record with the statement that any one particular aluminum alloy is best for the purpose of making match plates as numerous makers of such plates have developed alloys of their own which they believe are superior to others for this purpose. However, a good alloy to use is copper 8 per cent and aluminum 92 per cent, which is known as No. 12 aluminum alloy, and has a reputation as a good casting metal. The weight of this alloy per cubic inch is 0.10 pounds and as its specific gravity is a little over one-third that of cast iron, a good way to figure the weight of an aluminum casting made from an iron pattern is to divide the weight of the iron pattern by three. The aluminum casting would thus weigh about 5 ounces where a one pound pattern is used.

To get the weight of aluminum required in the case of a mold made from a wooden pattern, an easy way is to figure the weight as for cast iron then to take one third of this, which would be close enough for all practical purposes.

Bronze Bushing Alloy

We have an order to make a large bronze bushing to be used in an oil refining pump. The casting must resist sulphuric acid, have strength, as it must also resist great pressure, and wear well. Its weight will be in the neighborhood of 900 pounds. We desire to obtain a suitable formula.

The following alloy can be recommended:

BRONZE BUSHING ALLOY

	Per cent
Copper	89.00
Tin	10.50
Manganese copper	0.50

The latter alloy should contain 30 per cent manganese and should be free of iron. First melt the copper and when thoroughly liquid, add the manganese copper and lastly the tin.

Spindles Are Molded in Cores

A Temporary Frame Is Assembled Around Half the Spindle Pattern To Form Two Half Cores Which Afterward Are Assembled To Form a Whole Mold

IN THE ordinary routine of pattern shop practice, spindles, either straight or with rounded ends like the one shown in the accompanying illustration, are made from full patterns. The pattern may be split from end to end through the center so that it may be molded horizontally, or it may be parted at several points so that it may be molded vertically. The following method for making a spindle is not original, but under certain conditions it has proved advantageous and is submitted for the benefit of those who perhaps have had no opportunity of becoming familiar with it up to the present. The method is not necessarily confined to molding spindles, it may be applied to a wide variety of castings and under a widely varying set of conditions. The mold selected for illustration was an emergency job and will be described first, followed by comment on how the patternmaking end of the job might have been improved if the order had been for many castings instead of one.

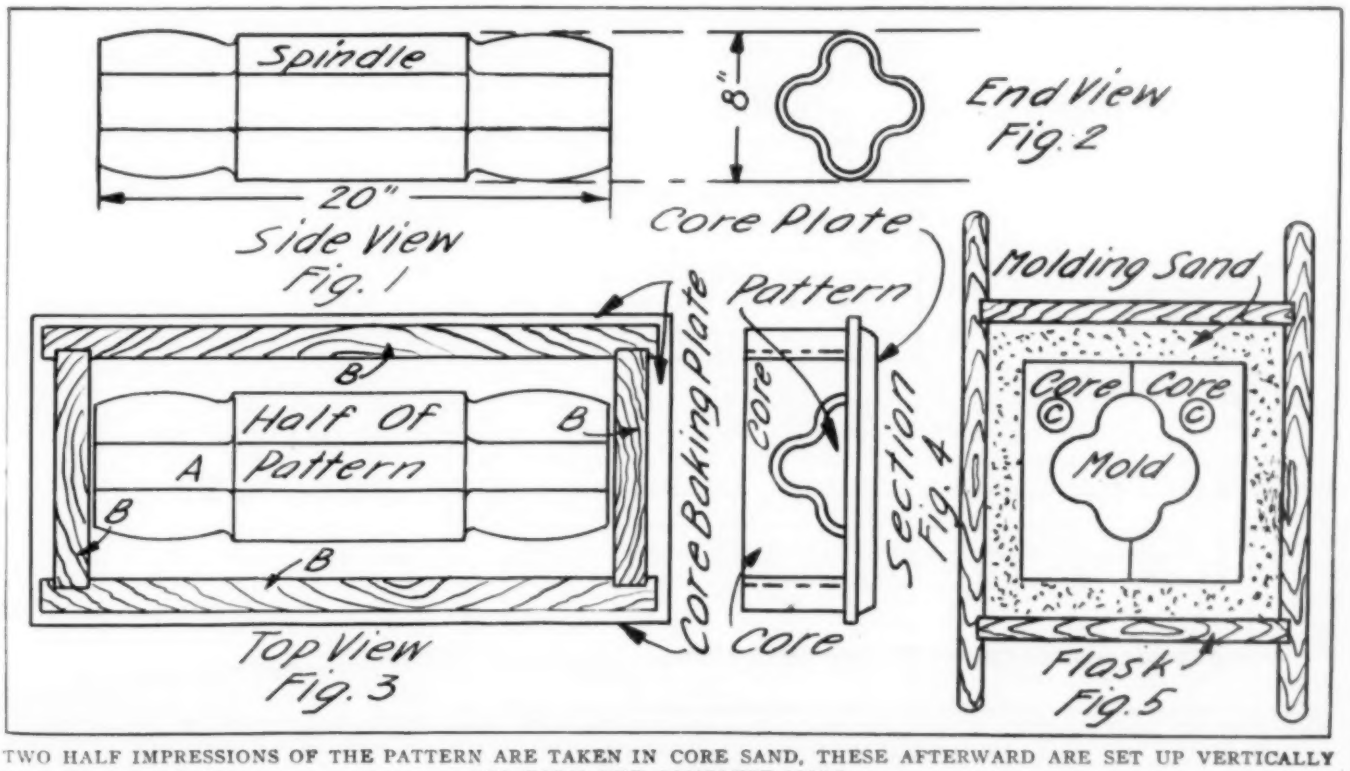
The foundryman selected the drag half of a split pattern and laid it on a smooth face bottom board. A frame *B*, Fig. 3, 4 inches wider and 2 inches deeper than the pattern was set on in such a manner that the two ends touched the pattern and the two sides were each 2 inches away. The frame was filled with core sand, rammed, a plate rubbed on and then all were rolled over together. The pattern was drawn, the frame removed and both replaced on the bottom board and the process repeated. The two half cores thus produced were dried and then assembled to form a complete mold as shown in Fig. 5.

A flat core was rubbed down to a bearing inside a drag and the two half spindle cores were erected on it. They were located in relation to each other by the molder passing his hand down the inside through the open top and feeling the joint with his fingers. Additional drags were set around the cores, filled with molding sand and rammed until they extended to the top of the cores. Here a second slab core provided with a number of small openings for the entrance of the metal, was set on and when the runner basin was built up the mold was ready for the iron.

In the event that many castings are required the patternmaker can fit up a pattern and core frame in an accurate manner that will eliminate any danger of a *shift* in the foundry. The half pattern can be attached permanently to the bottom board and in such a manner that it is located exactly in the center of the surrounding frame. By providing a suitable space at each end between the pattern and the core frame, the necessity of providing slab cores top and bottom when assembling the mold will be eliminated. The pattern may be extended the necessary distance at one end to serve as a sink head and the gate openings may be formed by a number of small rods extending through the end of the frame and pulled out before rolling the core over on the plate.

Reorganize Company

Reorganization of the J. H. Gautier & Co., Jersey City, N. J. recently has been completed with O. W. Bird Jr., president. Other additions to the personnel are as follows: F. J. Connors, formerly plant engineer of the Lumen Bearing Co., Buffalo and later development engineer for the National Aniline & Chemical Co.; George F. Fynn, formerly with the National Aniline & Chemical Co.; George L. Mead, formerly with the Waltham Foundry Co., and H. Richard Aaron of San Francisco.



TWO HALF IMPRESSIONS OF THE PATTERN ARE TAKEN IN CORE SAND, THESE AFTERWARD ARE SET UP VERTICALLY TO FORM THE COMPLETE MOLD

Molding a Propeller in Loam

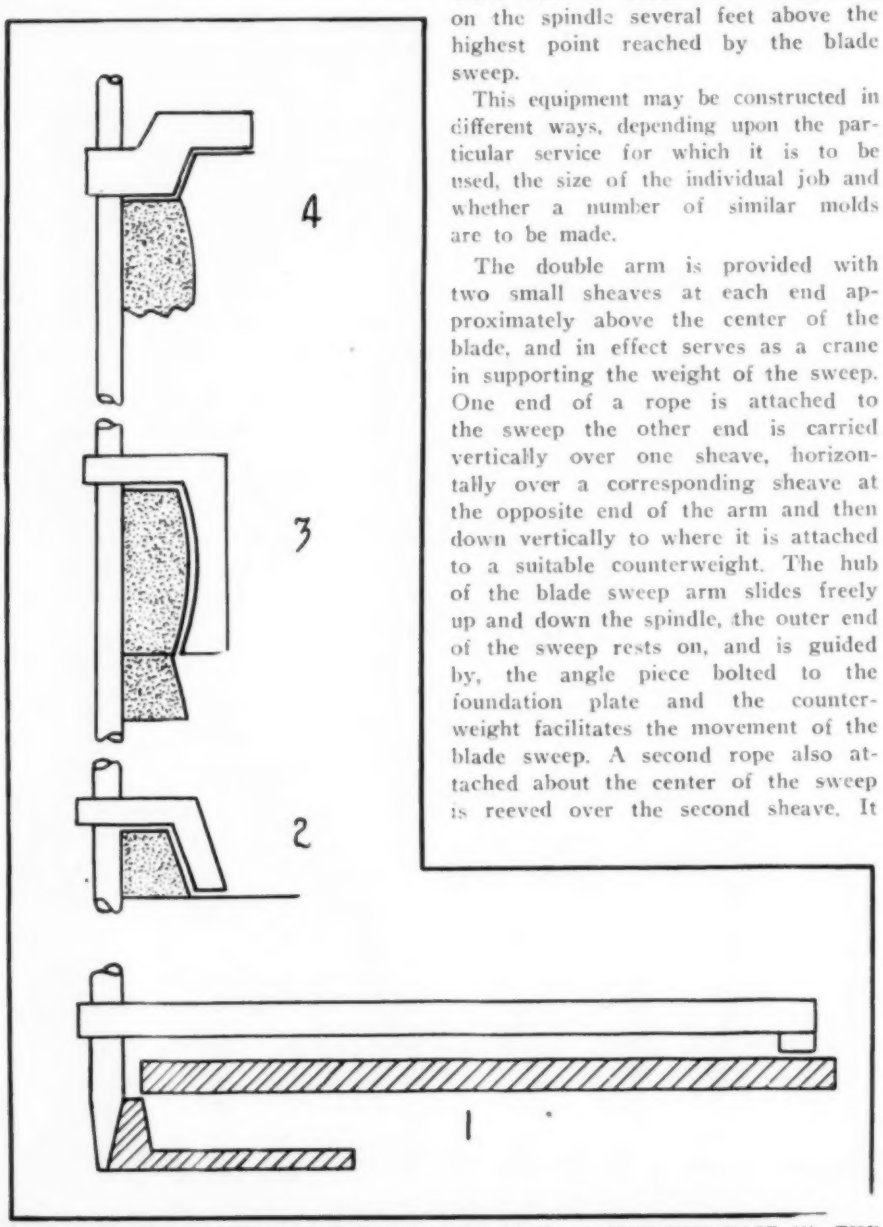
Intimate and Detailed Description of Methods and Rigging Employed for the Purpose—Necessity for Skill and Observance of Care and Accuracy Are Emphasized—Must Anchor Cope Securely When Pouring

BY LAWRENCE V. JOHNSTON

BEFORE starting to mold a large propeller quite a bit of planning is required so that when the time comes the copes may be anchored and tied down properly. The least lift on any one cope will result in a blade thicker than the others and an unbalanced wheel is of no service. The first requisite is a substantial foundation plate on which to build the mold. A circular plate is the most convenient form, it is at least 12 inches larger in diameter than the proposed wheel and is provided with a 6-inch hole in the center and a suitable number of lugs on the perimeter. A 6-inch opening affords ample clearance around the spindle and the lugs serve as anchors for the binder bolts. Other equipment includes a spindle and socket, a number of sweeps and sweep arms, an angle piece for each blade and a double arm supported on the spindle several feet above the highest point reached by the blade sweep.

This equipment may be constructed in different ways, depending upon the particular service for which it is to be used, the size of the individual job and whether a number of similar molds are to be made.

The double arm is provided with two small sheaves at each end approximately above the center of the blade, and in effect serves as a crane in supporting the weight of the sweep. One end of a rope is attached to the sweep the other end is carried vertically over one sheave, horizontally over a corresponding sheave at the opposite end of the arm and then down vertically to where it is attached to a suitable counterweight. The hub of the blade sweep arm slides freely up and down the spindle, the outer end of the sweep rests on, and is guided by, the angle piece bolted to the foundation plate and the counterweight facilitates the movement of the blade sweep. A second rope also attached about the center of the sweep is reeved over the second sheave. It is not attached to a counterweight. The molder pulls on the free end when he wants to lift the sweep straight up at many stages of the operation.



THE VARIOUS SWEEPS FOR FORMING THE RACE (1), THE HUB BASE (2), THE HUB (3) AND THE SEAT FOR THE SMALL COPE ON TOP OF THE HUB (4).

Where the molds for large propellers or other castings are swept regularly, permanent spindles and spindle seats are provided. Where one only is made occasionally it is necessary to bed down the spindle seat accurately and firmly. Many devices are employed for the purpose, but where only one casting is required a satisfactory foundation for the spindle seat is made by bedding several small plates on the floor. The spindle seat is placed on the plates; the spindle is lowered into place and carefully plumbed by driving wedges under the spindle seat at several points. On the mold for a propeller some of the sweeps and other parts of the equipment are set by square and rule and some are set by a level and therefore it is essential that the spindle be set absolutely plumb. Further the spindle should be rigid and not easily moved from a perpendicular.

Preparing the Foundation

The foundation plate may be set up on suitable blocks or bedded on the floor. In the latter instance a level bed is prepared by attaching a straight edge to one of the rams and revolving it in such a manner that a circular bed results slightly larger in diameter than the foundation plate, and at the same height as the top of the spindle seat. The spindle, arm and straight edge are removed temporarily and the foundation plate is lowered into place in such a manner that the opening in the spindle seat appears directly below and in the center of the opening in the plate.

A thickness of loam is spread on the outer part of the plate and a sweep with a shallow shoulder at the outer end is employed to form a guide near the perimeter of the plate for the *race* or angle frame which serves as a guide later for the outer end of the blade sweep. The circle is divided into six equal parts if a three-blade wheel is required. If the wheel is to have four blades the circle is

divided into eight equal parts. Suitable marks are made with a trowel and each line is projected from the rim to the center by using the edge of the sweep for a guide. After the small pedestal for the hub is built in the center and slicked, a center line is drawn from the rim to the hub between each of the other pairs of lines. These latter lines represent the center of each blade.

A temporary hub is built on the base. The brickwork purposely is built loosely because later it will be taken apart and removed before the copes are lifted. After the brickwork is covered with loam and swept to shape it resembles a small keg. The resemblance is accentuated by the vertical lines described in the sides. These lines form a continuation of the horizontal radial lines between the hub and the rim. They are drawn with the sharp point of a trowel using the edge of the sweep for a guide. The hub sweep is provided with a small V-notch at the center which leaves a raised guide line around the center of the hub. The point at which this line intersects the vertical projection of each of the horizontal center lines is the center point from which subsequent measurements are taken to determine the position of the blades. The design of the wheel determines the height of the center line on the hub and incidentally the height of the base supporting the hub. These dimensions of course are worked out in advance and the various sweeps made accordingly. The angle piece which determines the pitch of the blade is attached to the foundation plate in such a manner that a center line on the lower edge coincides with one of the blade center lines on the loam face of the plate. The angle piece is bent to the same diameter as the first large circle on the foundation plate and is fitted close up to the shoulder. Care must be exercised in joining the parts together in such a job.

To determine the position of the brickwork supporting the drag part of each blade the main sweep is lowered until the cutting edge coincides with the center line. The lower edge of the sweep is provided with a number of V-notches which later serve to locate the thickness strips used in forming the sand pattern for the blade. In the present instance the notch lines are projected vertically on the face of the foundation plate. The thickness strips are placed in position temporarily and the molder draws an outline mark on the plate to guide him in building the wall. A 4-inch wall for a cope bearing all around the blade usually is found satisfactory. The wall is built in the usual manner and the space inside is filled with bats and cinders. Several openings are provided in the back wall for the escape of the steam generated while the mold is drying. The upper part of the drag is formed from a course of *headers*, that is whole bricks laid on end, to afford stability to the face of the mold. The joint on the high side of the blade is formed by standing the headers perpendicular with the narrow face flush with the wall and with the inner edge just missing the sweep.

A horizontal joint along the upper edge prevents the cope from sliding. The joint at the end of the blade is a continuation of the face of the blade. The face of the mold is loamed and finished before the lower joint is prepared. This is due to the fact that clearance is required on the bottom for the blade sweep. After the sweep is lifted out of the way the lower joint is built up by hand. While the loam is stiffening on the face of the first drag, the molder builds up the remaining drags, then returns to the first and proceeds to build a sand pattern for the blade. The lower face of the sweep is notched in several places to provide guide lines on the face of the mold. The number of lines depends on the length of the blade. Usually the lines are spaced 8 or 10 inches apart. A number of thin wood strips corresponding to the thickness of the blade at each point indicated by the notch are placed on edge on the face of the mold. The lines are curved and the strips are bent to the curve and held in place by nails driven on both sides into the stiff loam. When all the strips are in place they form a skeleton outline of the desired blade. The space between the strips is filled with sand that is packed and slicked. A considerable degree of skill is required in forming the blade pattern, particularly along the edge. The entire number of blades is made in the foregoing manner and then the molder proceeds to adjust his copes. Before the copes are set on a perpendicular joint on a radial line from the center is formed on the back of each wall for a distance of 8 or 10 inches. The upper surface of the drag joint and pattern is oiled and the cope is set in place.

This is one of the jobs in which the molder practically makes all his own rigging and the methods do not differ to any material extent from those practiced 100 or even 200 years ago. Of course no propellers were made in those days, but equally complicated castings were turned out in a creditable manner. The cope is assembled from a considerable number of open sand castings including two or more arch pieces and several long straight pieces. The arch pieces are provided

FAKED FOUNDRY FACTS

A BUMPER

rows of holes and the long pieces are placed in these openings and wedged there. The arch pieces span the casting and the ends rest respectively on the top and bottom joint. The long pieces extend longitudinally from the hub to outer extremity of the blade joint and serve to support the rows of brick comprising the cope covering.

Assuming that only two arch pieces are required, they are designed to fit over the pattern at two points where the weight will be distributed in an approximately equal manner. In fact the ends of the arch pieces serve as handles. As a preliminary a piece of light rod is bent to confrom to the contour of the pattern and the adjacent joint lines top and bottom. In an occasional case the one rod will serve to form both arches, but usually it is necessary to bend a separate rod for each, one about one-third the distance between the hub and the tip of the blade and the other at the two-third distance point. The rod is placed on a board of the required thickness and width where the shape is marked with a pencil and sawed out on a band saw. The board is used as a pattern and is molded in open sand. Suitable rectangular cores are spaced along a center line about 5 inches apart and a round core is placed near each end to provide a receptable for a clevis or other form of device employed in rolling the copes after they are made.

Longitudinal Bars

The longitudinal bars also are made in open sand from a plain pattern that tapers to a narrow point at one end. The bars are long enough to cover the entire drag face from end to end and of such a cross section that they may be inserted easily into the openings in the arch or bow castings. A piece of pipe is bent to form an outline of the cope where it rests on the joint. The pipe passes through suitable holes in the bows and is wired to the ends of the longitudinal bars. The pipe usually is in two pieces and the ends are lapped and wired over the tip of the blade The long bars are adjusted to the best advantage and then wedged in the bows.

After all the copes are in place a small sweep is attached to the spindle to serve as a guide in adjusting a piece of small rod designed to carry the bricks immediately surrounding the hub. This rod is wired to the pipe and also wired to one or more of the projecting ends of the long bars. The sweep is employed later to form a seat for the small cope over the hub.

After the copes have been fitted they are removed temporarily until the joint on the drag has been repaired and covered with parting sand. They then are replaced and bricked in the usual manner with the bricks extending an equal distance above and below the frame work. The bricks are laid *tight* with the spaces above and below the strips packed with chips for solidity. The bricks that encase the hub are carried up to a point where a flat thickness of loam is swept on to form a seat for the hub cope.

At this point the spindle and last sweep are removed and a small cope is rammed on top of the hub. The hanging body of sand is carried by long gaggers or a small crab. In some instances a round covering core is employed. The cope is removed and finished and then the false work comprising the hub pattern is taken out piece by piece. The molding sand forming the blade pattern is removed for a distance of a few inches so that the molder may cut a set of uniform fillets at the junction of the hub with the blades. The blade copes are marked in the usual manner employed on loam molds where trowel marks are made in adjoining patches of loam daubed on for the purpose.

Turnbuckles are attached to the ends of the bows and adjusted to secure a level lift on the copes. Each cope is removed in turn and set down on suitable blocks on a cleared space on the foundry floor where it is rolled over and finished. After the copes are blacked it is optional whether they are placed in the oven and dried in that position or rolled over and placed on the drags with a few bricks or other suitable stands between the joint surfaces. The first method usually is adopted where ample oven facilities are available.

After the mold is dried it is cleaned and closed, preferably on the bed where it was built. The large copes are closed carefully one at a time, then the center core is set followed by the small cope over the hub. The vent from the center core is taken off through a small pipe that projects above the top of the runner box.

Describes Pouring Basin

Tying the mold together involves the use of a great deal of blocking. Long binders are placed above all the blocking and attached by long bolts to the foundation plate. Various points on the tops of the copes are wedged under the blocking. The outside of the mold is encased in a curbing and the space inside the curbing and over the copes rammed full of sand. The iron is poured into a basin close to the edge from which it travels in a long trough to the center and enters the top of the hub through a number of small pop gates. It is advisable to pour the iron rapidly until the mold is almost filled and then pour the remainder slowly to minimize the *lift* or strain on the mold.

Standardizing Cost Finding Methods

IN MANY job welding shops, and in some other organizations where much welding is being done, the keeping of accurate cost records has reached a high degree of development, says *Oxy-Acetylene Tips*. Exact figures covering welding are of distinct benefit to the shop. Space is provided for items such as preparing parts for welding, preheating, if this is necessary, welding, and any annealing or finishing found to be advisable. In addition to this, provision is made for recording the quantities of gases, welding rod and other supplies used. To the total cost of these factors is added a percentage amount to cover overhead and general expense.

In some other shops, however, and this classification includes some of the largest welding shops in the country, the matter of cost accounting has not reached this degree of standardization, and prices to the customer are based in many instances upon the price of a new or replacement part, or on a roughly estimated cost of a job, rather than upon a cost actually based upon definite time, material and overhead figures. It seems reasonable to suppose that in some cases of this kind welding shops are doing themselves injustice by their failure to secure sufficient revenue for the work they do, and that in other cases customers are overcharged, this resulting in the loss of good will by the welding process as a whole, as well as the welding shop engaged in doing the work.

The accompanying illustrations indicate how one progressive welding shop has solved the cost problem, and how cost finding has been standardized in its particular case. This system has

been in operation for a considerable time, and the success of the company using it, based to some extent at least upon the good will which has been built up among its customers, indicates that it might be advisable for other shops to adopt similar methods.

The basis of this system consists of three cards, two of which are illustrated. The third card is the operator's daily record of work accomplished, and simply lists the various jobs on which the individual welder works during the day, together with a record of the time spent on each job.

When a welding job is received in the shop, part of the office record, Fig. 1, is filled out. This card bears the job number, the name and address of the customer, the date the job is received in the shop, the date the finished work is promised the customer, and the name of the shop employe or official accepting the job. Any special instructions or suggestions given by the customer are noted on the reverse side. This card then is used as a guide in making the preliminary entries on the shop record card which travels through the shop with the job, after which this office record card is filed in the office until the welding is completed and the finished work is ready for the customer.

The shop record card, Fig. 2, is numbered to correspond with the office record of the job, and shows the date for which the finished work has been promised to the customer. This card does not bear the customer's name, the work being identified in the shop by number only. As the work progresses step by step, the operator records the amount of welding rod used, the number of cubic feet of oxygen and acetylene consumed and the quantities of charcoal and other supplies used in preheating, annealing and finishing. A time-clock record of the work done is kept on this card by the operator, who punches the card whenever he starts and finishes working on the job. While the welding is going on the operator follows the customer's special instructions which are transcribed on the back of the job card from the office record card.

When the work is finished the job card bears a complete record of the time and supplies used. These figures are posted on the office record card in the office, and the cost of the work determined. This cost includes the overhead factor, this factor having been reduced to a percentage of the value of the time and material used. The net profit is based on a percentage of the costs, the total of these preceding items thus determining the fair selling price to the customer.

Of course, this cost system easily can be modified or altered to meet specific needs or conditions met in other shops. However, in every case, standardization along cost finding and price fixing lines has been of a distinct benefit to the shop operating the system.

Want Rates Changed

The American Sand association is endeavoring to obtain a readjustment in the freight rates now being charged for interstate shipment of various kinds of sands. The association is asking that the railroads cease to distinguish between the different uses to which the sand is put in determining the rates to be charged. Recently the general committee of the Central freight association granted the sand association a hearing at Chicago on the question of uniform rates on sand. E. E. Klooz, vice president of the Portage Silica Co., Youngstown, O. and president of the American Sand association, F. R. Thrall, secretary and treasurer of the Geauga Silica Sand Co,. Cleveland and chairman of the traffic committee of the association and Herbert B. Fuller, secretary of the association, appeared before the freight association and presented the arguments for the change.

Move Main Office

The main office of the Illinois Clay Products Co. has been removed from Oglesby, Ill., to Joliet, Ill. The company has opened a new fire clay grinding and washing plant in the vicinity of the latter city.

Fred J. Mershon, for a number of years export manager of the Industrial Works, Bay City, Mich., now is in charge of the Detroit branch office located in the Book building.

JOB NO.

Job Welding Cost Sheet
Customer's Name
City
Date when Job received
Date when Job promised
Date when Job finished
Job taken by
Job settled by

LBS.	MATERIAL	@	TOTAL	@	TOTAL
	Brass Rod				
	Copper Rod				
	Aluminum Rod				
	Steel Rod				
	Cast Iron Rod				
	Charcoal				
	Asbestos Paper				
	Gas				
	Gasoline				
	Feet Oxygen				
	Feet Acetylene				
	Hours Time				
	Overhead				
Total Cost					
Total Selling				Charge	
Total Profit					
Remarks on back of this Sheet					

JOB NO.

JOB WELDING CARD

COPPER ROD Size	COPPER ROD Lbs.	BRASS ROD Size	BRASS ROD Lbs.	ALUMINUM ROD Size	ALUMINUM ROD Lbs.	BRIGHT STEEL ROD Size	BRIGHT STEEL ROD Lbs.	CAST IRON ROD Size	CAST IRON ROD Lbs.	FEET AGEY	FEET OXEY

	ELAPSED TIME	CLOCK RECORD
Start		
Stop		
Start		
Stop		
Start		
Stop		
Start		
Stop		
Start		
Stop		

Lbs. Charcoal for Pres Heating or Anealing	Lbs. of Asbestos Paper	Gas or Gasoline

ANY OTHER MATERIAL USED MARK ON BACK OF CARD

Remarks

Workman's Signature

Date Promised

FIG. 1—LEFT—THE OFFICE RECORD CARD USED IN MAKING PRELIMINARY ENTRIES ON THE SHOP RECORD CARD, SHOWN IN FIG. 2, ABOVE

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Where Integrity Is Appreciated

A PROMINENT western foundryman in charge of a shop which is the key department of a large manufacturing establishment was asked whom he considered the most valuable man in his force. He answered without hesitation, "Our rate setter." He then explained the basis for this appraisal. The individual who sets the piecework price in this shop is possessed of the judgment of Solomon, according to his executive chief. When a time study is to be made, the foreman in charge of the particular job informs the rate setter and he in turn advises the molder or coremaker in charge. Thus, the workman knows that a study is being made, a practice which has been disparaged by many efficiency experts. However, in this case the rate man has established such a reputation for fairness that an operator rarely tries to fool him. The rate setter explains that he represents both the company and the individual in each case. He occupies a judicial position. He makes this plain to the workman and states further that if he favors the individual in one case he is just as likely to lean too far toward the the interests of the company in the next instance. The latter chance, he states, is more than likely to arise should he realize from later production that a workman has stalled or attempting to *soldier* on a job under investigation. Further, a time study is not attempted on any job until the man in charge has worked long enough to master its various operations. Only men who are new to the organization, who do not realize the rate setter's fairness ever attempt any trickery, is the confident opinion of the superintendent.

Picking New Outlets for Old Products

MORE than bovine psychology was expressed in the statement that the grass on the other side of the fence always is greener. When business is bad and orders are few, foundrymen look with favor on lines of castings other than those which they can and do make. Occasionally they cross the barrier of precedent and find the pasturage more succulent in their neighbor's field, but more often the thistles, not visible from a distance rob them of the anticipated business banquet. The fallacy that sashweights form a profitable fillin job for dull times is an example of this attempt to make untried classes of castings. True, some shops make money on ventures of this nature, but in the main the outcome is disastrous for the one unfamiliar with the work and results in lower prices to the regular manufacturer. Perhaps more complete mastication will draw more nourishment from the domestic herbage. Consider the manufacturer of cast iron pipe, a foundry commodity long used for water mains and other municipal service, but shunned by oil and gas interests in favor of rolled pipe. Recently a large southern maker has adopted a method of welding which permits the use of straight end pipe. Sections are joined so that the line may be used to carry either oil or gas under pressure. Some of this pipe is under service in the West at present. This opens up a new field of usefullness for a standard foundry product. It broadens the market and will result in more business for the entire pipe making industry.

Trade Outlook in the Foundry Industry

WHILE the period from April 15 to the present time represents a descending scale in business activity, conditions in the foundry industry are in no way alarming. True, operations are spotty, depending upon the state of activity or lack thereof among the manufacturing, building construction and new improvement lines which combined make the castings market. The low point in foundry activity probably is that great group of shops which make automotive castings, while the most prosperous plants are the various cast iron pipe foundries. Between these two extremes are found the other diversified lines of castings production.

Curtailment Noted

Recession is apparent in many lines and industry in general is experiencing a setback. However, the drop is not so sharp nor so pronounced as many individuals believe. The monthly fuel survey of the National Association of Purchasing Agents discloses that on a daily average basis, April shows a decline of only 7.5 per cent as compared with March when the total amount of coal consumed in industrial plants is considered. The same report indicates that April of this year is 16 per cent behind the same month of 1923. Railway shipments have declined and in close accord, the car awards for the past two months have dropped. March showed a total of 13,145 cars ordered, April only 10,253 and February which marked the peak of car buying a total of 41,396 cars. Railway foundries continue active on existing orders and car repair contracts are satisfactory. A noteworthy feature of the railway market is the increasing demand for specialties and a smaller volume of direct orders for miscellaneous supplies and equipment.

Prices for Raw Material for Foundry Use

CORRECTED TO MAY 22

Iron		Scrap	
No. 2 Foundry, Valley	$21.00 to 21.50	Heavy melting steel, Valley	$15.75 to 16.00
No. 2 Southern, Birmingham	21.00 to 22.00	Heavy melting steel, Pitts.	16.00 to 16.50
No. 2 Foundry, Chicago	22.50 to 23.00	Heavy melting steel, Chicago	14.00 to 14.50
No. 2 Foundry, Philadelphia	22.76 to 23.26	Stove plate, Chicago	17.00 to 17.50
No. 2 Foundry, Buffalo	20.00	No. 1 cast, Chicago	19.75 to 20.25
Basic, Valley	20.00 to 21.00	No. 1 cast, Philadelphia	16.50 to 17.50
Basic, Buffalo	20.00 to 20.50	No. 1 cast, Birmingham	19.50 to 20.00
Malleable, Chicago	22.50 to 23.00	No. 1 cast, Buffalo	18.25 to 19.00
Malleable, Buffalo	20.00 to 20.50	Car wheels, iron, Pittsburgh	16.00 to 16.50
Coke		Car wheels, iron, Chicago	16.50 to 17.00
Connellsville foundry, coke	$4.25 to 5.00	Railroad malleable, Chicago	18.50 to 19.00
Wise county foundry, coke	4.50 to 5.50	Agricultural mal., Chicago	17.50 to 18.00
		Malleable, Buffalo	19.00 to 19.50

Automotives Stagnant

The outlook in the automobile industry is variously interpreted. Many are inclined to view the present lull as temporary, to be blamed upon the late season and disturbing factors in business and politics. Automobile production in April dropped only slightly below March. The total reported for last month by the department of commerce is 373,139 compared with 32,456 for March. The greatest loss has been noted by individual makers, since the first of May. Demand for closed cars is reported as in excess of the present supply, but in open models and trucks, many manufacturers have cut production and a few are said to have stocked large numbers in warehouses. Early announcement of new models is expected to stimulate demand. Automotive foundries are affected in various degrees, although practically all of them have been forced to reduce schedules. One large maker is operating only about half time and at a daily rate equivalent to about one-third of that obtaining during the first few months of the year. However, little pessimism is evident and all seem to view the conditions are temporary.

Building Declines

March registered a high total in building awards. By contrast April showed a sharp drop, reversing the usual seasonal condition. Further, high costs and a lessening margin between supply and demand, particularly for residence construction seem to presage further declines. This condition has not yet affected the demand for sanitary ware, soil pipe and fittings and the numerous classifications of builders hardware which require a large total tonnage of castings. Demand for domestic machinery of all classes remains strong. According to the American Washing Machine association, dealers increased their sales of washing machines by a total of 20.5 per cent during 1923. The total sales of this division of domestic necessities reached $60,500,000. Sales of the diversified lines of electrical devices for home use likewise increased and the cumulative demand is such that increased sales are expected during the present year with a continuation of satisfactory employment. Conditions in jobbing castings lines are varied. In Indiana, steel foundries are operating on a schedule representing from 50 to 60 per cent of capacity, while malleable shops are slightly below this figure and gray iron still less active, although occasional exceptions are noted. Some slight improvement in general jobbing foundry operations is noted. Steel foundries in the vicinity of Pittsburgh are able to maintain a schedule of about 80 per cent of capacity sustained by the demand from car builders. The April total of steel castings orders booked, according to the department of commerce represented about 82.1 per cent of capacity, compared with 101.3 per cent for March. The larger makers of electrical machinery report demand for large equipment is sustained at 85 to 90 per cent of capacity and for small motors, etc., is slightly lower, averaging 75 per cent.

Nonferrous Prices

New York prices on nonferrous metals, according to reports in the *Daily Metal Trade* of May 22, follow: Casting copper, 12.50c to 12.62½c; electrolytic copper, 12.80c to 12.85c; Straits tin, 41.00c; lead, 7.20c; antimony, 8.50c to 8.62½c; nickel, 30.00c; aluminum, No. 12 alloy, remelt, 21.00c to 22.25c. Zinc is 5.70c to 5.75c, E. St. Louis, Ill.

Personal

F. F. Elliott has been made works manager of the Cleveland foundry of the Westinghouse Electric & Mfg. Co., succeeding Charles F. Knowlton who died recently. Mr. Elliott who was transferred from the Springfield, Mass., foundry of that company where he held the position of foundry superintendent, was born in Kent, O., Feb. 11, 1872. He learned the patternmakers trade with the Bucyrus Steam Shovel & Bridge Co., Bucyrus, O. He then worked at various plants, spending two years in the employ of the Standard Sanitary Mfg. Co., Pittsburgh. Twenty-two years ago he entered the employ of the Westinghouse Electric & Mfg. Co., as a patternmaker at the Allegheny foundry, North Side, Pittsburgh. In 1907 he was made foreman of the pattern shop and in 1916 he was transferred to Cleveland where he held the same position. In May, 1916 he assumed charge of the brass foundry at the East Pittsburgh plant of the Westinghouse company. He held this position for four years, and upon the erection of a foundry in Springfield, Mass. in 1920, he was made foundry superintendent there.

Thomas Vickers has resigned from the British Cast Iron Research association and has commenced private practice as a foundry consulting engineer with offices at 14 New street, Birmingham, England.

Oliver Smalley, foundry engineer and metallurgist, Rotherham, England, expects to sail shortly on a trip through the eastern part of the United States. He expects to spend a few weeks in that country studying American foundry methods.

Charles H. Eglee, industrial counselor to the Massachusetts Leather Manufacturers association and John Williams, director of industrial relations, Yale & Towne Mfg. Co., Stamford, Conn., spoke before the New England Foundrymen's association, May 14, on industrial relations.

Robert J. Young, practical steel melter at the United States Naval Steel Foundry, League Island navy yard, spoke before the Philadelphia Foundrymen's association, May 14, on his experience in melting cast iron in the electric furnace. Horace Dreaver, Electric Furnace Construction Co., Philadelphia, described the latest improvements in the electric furnace.

John F. Gaffney, formerly with the Allis-Chalmers Co., Milwaukee and the Bethlehem Steel Co., Sparrows Point, Md., has been employed as foundry superintendent of the Hadfield-Penfield Steel Co., Willoughby, O. That company will manufacture all of their gray iron and semisteel castings in the Willoughby foundry in the future, thus necessitating a change in plant facilities.

Mining Engineers Meet

The national exposition of coal mining machinery and equipment of the American Mining Congress held in the Music Hall, Cincinnati, May 12-17, presented many interesting features including mechanical coal loaders in actual operation, latest improvements in electric locomotives, mine cars, trackwork, hoists and numerous haulage and hoisting equipment with the latest developments in drilling, and mining machines, explosives, ventilating and pumping equipment.

The American Mining Congress held joint technical meetings during the week, with the National Coal association which brought together a large body of executives, operating men and engineers. The chief points brought out at the several meetings were the necessity of a closer understanding of the other's working plans and a greater co-operation between the different working units of the industry.

A number of important meetings were held by the standardization division of the American Mining Congress under Col. Warren R. Roberts, chairman. These covered the coal and metal mining branches which are divided into general and sub-committees. Many important questions were discussed and plans formulated for the presentation of reports covering the several committees on standardization at the convention of the American Mining Congress to be held at Sacramento, Cal., during the week of Sept. 29.

Elects Officers

John C. Ploehn, superintendent of French & Hecht, Davenport, Ia. was elected president of the Quad City Foundrymen's association at a meeting held in the LeClair hotel, Moline, Ill., Monday, May 5. P. T. Bancroft, John Deere Harvester Works, East Moline, Ill., was elected vice president and Alec Matheson, French & Hecht secretary and treasurer. The following were placed on the board of directors; A. E. Hagebock Frank Foundries Corp., Moline; Fred Kerby, Marseilles Works, East Moline, Roy Schofer, Rock Island Plow Co., Rock Island Ill., Pete Bendixen Bettendorf Co., Bettendorf, Ia.; John Diedrich, Blackhawk Foundry Machine Co., Davenport.

Discusses Production of High Test Bronzes

"The United States leads the world in the development and production of high test bronzes," said C. R. Spare, president and general manager of the American Manganese Bronze Co., Philadelphia, at the regular monthly meeting of the Pittsburgh Foundrymen's association held at the General Forbes hotel, Pittsburgh, May 19. In his paper entitled "High Test Bronzes for Enginering Uses" he discussed the ancient history of copper and described the various alloys that had been developed as well as the various applications to which gunmetal bronze, manganese bronze, phosphor bronze, aluminum bronze, steam turbine bronze, etc., are being put. He said that the use of these materials has grown rapidly during the past 10 years as engineers are paying more attention to their desirability under service. The American Society for Testing Materials publishes 30 specifications, the United States navy department 25, war department 40, and air service 18, so that these brasses and bronzes are more and more being specified for various uses where stresses and strains have to be withstood. Mr. Spare had various test bars, specimen sections, etc., to illustrate his points as well as a large number of lantern slides showing both large and small sections made from these materials.

At this meeting new officers were elected and several changes to the by-laws and constitution of the association were adopted. Tentative plans also were announced for the annual picnic to be held in June at the Pines, near Pittsburgh. The new officers for the ensuing year are as follows: President, Ralph W. Jones, Union Switch & Signal Co., Swissvale, Pa., to succeed John W. Guay of the Fort Pitt Steel Castings Co., McKeesport, Pa.; vice president, William K. Frank of the Damascus Bronze Co., Pittsburgh, to succeed Mr. Jones; secretary-treasurer, William J. Brandt, 1001 Bessemer building, Pittsburgh, re-elected. The new executive committee is as follows: John W. Guay, B. F. Schuchman, Homestead Valve Mfg. Co., Homestead, Pa.; L. V. Stevens, Locomotive Stoker Co.; J. S. McCormick, J. S. McCormick Co., and L. B. Snow, Hickman-Williams Co., Pittsburgh.

The Ideal Concrete Machinery Co. has moved into its large new factory at 5000 Spring Grove avenue, Cincinnati. The company also has issued a new 80-page loose leaf catalog illustrating the line of concrete machinery and foundry equipment made in its plant.

Equipment Buying Is Delayed

Users Are Waiting for a Change in the Business Situation—After Upturn Noted Several Weeks Ago, Inquiries Again Are Light—Sales Heavier at Pittsburgh

WHILE a substantial increase in inquiries for foundry equipment was noted two weeks ago, a falling off in volume now is found in practically all distributing centers. An exception to this condition is noted in the Pittsburgh district where inquiries seem to be more plentiful. Sales in all sections are light, users of machinery in most cases holding off for future developments. Manufacturers disagree widely as to the probable future of the equipment market. The W. W. Sly Mfg. Co., Cleveland, has sold a sand-blast cabinet to the Dayton Steel Foundry Co., Dayton, O. The former company also sold tumbling mill equipment to the Fanner Mfg. Co., Cleveland, the New Foundry Appliance Co., Trenton, O., the International Harvester Co., Springfield, O., and the Champion Hardware Co., Geneva, O. Sand blast and dust arrester equipment has been sold to the Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., and sand blast equipment to the National Pipe & Foundry Co., Attalla, Ala., by the Pangborn Corp., Hagerstown, Md.

Inquiries Falling Off in West

MAKERS of foundry equipment in the Chicago district are finding inquiry falling off somewhat. However, if only a fraction of the business held up pending improvement in the foundry industry would materialize a good volume would be realized. Recent sales of sand mixers by the National Engineering Co., Chicago, include units to the Colorado Fuel & Iron Co., Denver; Reed Foundry, Kalamazoo, Mich., and the Westinghouse Air Brake Co., Wilmerding, Pa. The Ford Motor Co., Highland Park, Mich., has purchased special sand blast equipment from the W. W. Sly Mfg. Co., Cleveland. Tumbling mill equipment has been sold to Green's Car Wheel Mfg. Co., St. Louis, the American Steel Products Co., Macomb, Ill., Dodge Bros., Detroit, the Studebaker Corp., South Bend, Ind., and the La Crosse Plow Co., La Crosse, Wis. by the W. W. Sly Mfg. Co. The latter company also has sold dust arrester equipment to Green's Car Wheel Mfg. Co. The Pangborn Corp., Hagerstown, Md., has sold dust arrester equipment to the Allis-Chalmers Mfg. Co., Milwaukee, and the Packard Motor Car Co., Detroit. The Drying Systems, Inc., Chicago., has placed a core oven with the Buckeye Steel Castings Co., Columbus, O.

Equipment Buying Light in East

FOUNDRY equipment buying in the eastern district is the lightest it has been this year, according to leading sellers. With few exceptions current orders do not include more than one or two items, and in virtually all cases, buying is for replacement purposes. At the moment, there are few new foundry projects under consideration, and this, in conjunction with the slowing up in business generally, promises little in the way of a revival in the immediate future. A recent order calls for 1000-foot monorail system for the Frankfort, N. Y., foundry of the New York Central railroad, this business going to the tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O. A list of four small pouring cranes is included. The Boynton Furnace Co., Jersey City, N. J., continues to figure on molding machines, core ovens, and some other miscellaneous equipment for its new plant extension. The W. W. Sly Mfg. Co., Cleveland, has sold tumbling mill equipment to Ingersoll-Rand Co., Painted Post, N. Y. and the Pangborn Corp., Hagerstown, Md. is furnishing sand blast and dust arrester equipment to the T. H. Symington Co., Rochester, N. Y. Notwithstanding the slowing up in business, prices on the various lines of equipment are holding fairly steady at levels which have prevailed throughout the greater part of the past five months. This steadiness applies particularly to molding machines, and sand cutters. Sellers of this latter equipment, incidentally, assert that there is considerable buying by the pipe foundries, who are operating at the highest rate of any class of foundries in this district. A fairly good demand prevails for flasks and other supplies.

New England Business Is Quiet

SALES of equipment throughout New England have been quiet since the first of May. Foundry production in the district is about holding its own, but buying conservatism is widespread. Such sales, as have been made have been almost exclusively in connection with foundry extensions or new plants. The Rhode Island Malleable Iron Co., Providence, R. I., has let a contract for a plant extension and has bought molding machines and other equipment. The Mansfield Foundry Co., Mansfield, Mass., is planning alterations and additions and has bought equipment including a 10-ton crane. The Weir Stove Co., Taunton, Mass., and the Guerney Heater Mfg. Co., Framingham, Mass., have both been in the market for miscellaneous equipment. The Pangborn Corp., Hagerstown, Md., has sold sand blast equipment to the Connecticut Foundry Co., Rocky Hill, Conn. Twelve pressure type blast mills equipped with bucket elevators, pressure tanks and dust arrester equipment have been sold to the General Electric Co., West Lynn, Mass., by the W. W. Sly Mfg. Co., Cleveland. The General Electric Co. alse has purchased a sand blast room and accessories from the same company for installation at Pittsfield, Mass. A recent improvement is reported in buying of foundry supplies. Equipment prices have held firm throughout the dull period.

Pittsburgh District Sees Improvement

IN SOME respects the foundry equipment market the the past few weeks shows measurable improvement over the situation as outlined by sellers early in May. Inquiries seem to be more plentiful but sales are few. There appears to be a certain amount of hesitancy about making expenditures as long as general foundry operations continue problematical. Included among the inquiries pending since about the first of the year is that of the Mackintosh-Hemphill & Co., Pittsburgh, for grinding machines, electrical tools, etc., for one or more of its plants. Various other foundries in the Pittsburgh territory are

figuring on equipment of this nature and may buy within the next few weeks, particularly should business show a sudden turn toward improvement. The General Foundry & Machine Co., Pittsburgh, is not ready to consider equipment for its new brass and bronze foundry at McDonald, Pa. The Bessemer Gas Engine Co., Grove City, Pa., inquired for a 60 x 72-inch planer, 25-foot bed, motor-drive, with two side heads and two heads on the rail. The American Malleable Castings Co., Marion, O., probably will close soon on new core oven equipment for its new building. The Westinghouse Airbrake Co., Wilmerding, Pa., is in the market for various types of equipment for its new brass foundry addition, including 3-ton and 5-ton cranes as well as hoists; Bernard H. Prack, Pittsburgh is engineer. The Carnegie Steel Co.'s equipment requirements for Homestead, Pa., are understood to include some types of foundry machinery. A fair amount of smaller supplies such as riddles, flasks, wheelbarrows, etc., continues to be moved each week, although many foundries in this vicinity are well equipped in those respects on the basis of present operating schedules. Occasional purchases of molding machines are reported by the Herman Pneumatic Machine Co., Pittsburgh, which interest, however, is entertaining a large number of inquiries which give promise of early closing. Most of these inquiries are for single installations, although a number call for several at a time. Included in recent sales are the following: Five to the American Radiator Co., Buffalo; three to the General Electric Co. for its steel foundry at Lynn, Mass.; two for the Duquesne Steel Foundry Co., Coraopolis, Pa., and one each to the following: Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; Damascus Crucible Steel Castings Co., New Brighton, Pa.; Tennessee Coal Iron & Railroad Co., Birmingham, Ala., and Sutton, Steele & Steele, Inc., Dallas, Tex. Tumbling mill equipment has been sold to the Hatboro Foundry Co., Hatboro, Pa., and Dilworth Porter & Co., Inc., South Pittsburgh, Pa. by the W. W. Sly Mfg. Co., Cleveland. The Pangborn Corp., Hagerstown, Md., has sold sand blast equipment to the J. W. Pohlmann Foundry Co., Buffalo, and a dust arrester installation to the Reading Steel Casting Co., Reading, Pa. Occasionally an inquiry for ladles and other types of the equipment are handled by the Whiting Corp., Harvey, Ill., but sand blast, sand cutting, handling or conveying equipment inquiries are in the minority at present. The largest sale of crane equipment noted recently is that of the Northern Engineering Works, Detroit, to the Erie Steam Shovel Co., Erie, Pa., involving three 5-ton cranes and one 25-ton crane. The Lorain Steel Co., Johnstown, Pa., bought a 20-ton, 4-motor crane from the Pawling & Harnischfeger Co., Milwaukee, and is understood to be in the market for a limited amount of smaller foundry equipment. Demand for other material handling equipment is good.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Morel Foundry Corp., Seattle, has been incorporated for $12,000 by C. M. MacDougall, 1508 Twenty-eighth avenue, and associates.

Donaldson Iron Co., Emaus, Pa., plans a 1-story machine shop on Broad street. The company operates a gray iron foundry.

The Portland Wire & Iron Works, 294 Second street, Portland, Oreg., plans 1-story addition to its gray iron foundry.

The H. T. Foundry Co., Cleveland, has been incorporated for $1000 with W. H. Thomas, Society for Savings building, as attorney.

H. S. Lee Foundry & Machine Co., Plymouth, Mich., is rebuilding the damaged portion of a foundry recently ravaged by fire.

J. H. Taylor, 91 Homes street, Quincy, Mass., will build a 50 x 100-foot 1-story foundry.

Clarence P. Hartmand and George D. Bishop, Oley township, Pa., are reported seeking a plant at Reading, Pa., to manufacture a newly-patented foundry product.

Badger Gray Iron Foundry Co., Milwaukee, has been incorporated for $10,000 preferred and 100 shares no par value common stock, by Frank E. Shields, F. Graff and A. A. Butzen.

The British Columbia Valve Co., Ltd., Vancouver, B. C., contemplates erecting a valve plant and brass foundry in North Vancouver, B. C.

Harriston Stove Co., Harriston, Ont., is completing arrangements for an addition to its plant. The company operates gray iron and aluminum foundries.

E. G. Stage, Lincoln, Neb., has organized a jobbing foundry. He formerly was connected with the Westover Steel & Iron Works as superintendent.

The Dominion Steel Equipment Co., Ltd., Toronto, Ont., has been incorporated with $50,000 capital, to manufacture and deal in iron, steel, metals, castings, forgings, etc., and conduct general foundry and machine shop business, by John B. O'Brien, James M. Forgie and Mathew L. Foster.

The Atchison, Topeka & Santa Fe railroad, Kerckhoff building, Los Angeles, has awarded construction contracts for a 1-story, 180 x 220-foot machine shop at San Bernardino, Cal.

Northwestern Iron Works, Devils Lake, N. D., has under consideration constructing a 1-story foundry at 402 Second street. S. A. Hann is president.

French & Hecht, Davenport, Iowa, are planning additions to include a one-story building 150 x 220 feet. Frank D. Chase, Inc., 712 North Michigan avenue, Chicago, is the engineer.

The Ajax Metal Product Pattern Co., Milwaukee, has been incorporated to manufacture metal patterns, templates and other foundry supplies, by LeRoy Christensen, J. G. Donahue and C. Thieme.

Barrows Lock Co., Lockport, Ill., is having plans prepared for a 1-story, 62 x 100-foot brick constructed brass foundry. Charles W. Webster, Cutting building, Joliet, Ill., is architect.

The Flint Malleable Castings Co., Flint, Mich., has been incorporated with $50,000 stock to make malleable iron and other castings by John M. Barringer, 402 Third street, Charles H. Bonbright and Carl Bonbright.

Globe Furniture Co., Waterloo, Ont., is completing plans for erecting foundry and machine shop and will shortly be in the market for equipment. John Bahnsen is manager. *Noted May 15.*

The Yale & Towne Mfg. Co., Stamford, Conn., plans constructing 1-story foundry addition. The company operates gray iron, brass and aluminum foundries and manufactures hardware, etc.

Hall Steam Pump Co., Galveston, North Side, Pittsburgh, has prepared plans for erecting large plant on the former Stonecrete Corp.'s 3½-acre tract at Acmetonia, near Cheswick, Harmer township. The Hall company operates a gray iron foundry.

American Malleable Castings Co., Marion, O., is constructing a new core building and is making power plant additions. Frank D. Chase, Inc 712 North Michigan avenue, Chicago, is the engineer.

The Peck, Stowe & Wilcox Co., 2176 West Third street, Cleveland, manufacturer of hardware, etc., has retained the H. K. Ferguson Co., that city, as engineer, to construct 50 x 100-foot forge shop and 3-story plant. The company operates gray iron and brass foundries.

Lovelace Engineering & Mfg. Co., Oldsmar, Fla., which recently acquired the Oldsmar Mfg. Co., will enlarge and improve the properties, constructing an addition for another cupola. T. L. Lovelace is president of the Lovelace company.

Greenville Steel & Foundry Co., Greenville, S. C., has been incorporated for $30,000 and has leased a plant for the manufacture of structural and machinery castings. Edward McCrady and E. D. Roy are among the incorporators.

The Eagle Iron Works, East Third street and Court avenue, Des Moines, Iowa, has moved into its new plant at Holcomb and Watson avenues. The new plant consists of a foundry, 70 x 120 feet; 80 x 120-foot machine and structural shop and a 2-story pattern storage and warehouse building. George W. Aulmann is president, Theodore Aulmann vice president and general manager and W. J. Galt, secretary and treasurer.